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GREEN GOLD: UNEVELING THE HEALTH AND NUTRITIONAL SECRETS OFMORINGA

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ABSTRACT

Mother nature has always given us essential medicinal plants for long decades. Moringa oleifera is a multipurpose herbal plant use as human food and alternative for medicinal purpose worldwide. It has been identified by researchers as a plant with numerous health benifits. Including nutritional and medicinal advantages. Moringa Oleifera contains essential amino acids, carbohydrates in leaves and components with nutraceutical properties supporting the idea of using this plant as a nutritional supplement or constituent in food preparation. Some nutritional evaluation has been carried out in leaves and stem. Its leaves, seeds and pods contains high concentration of vitamins A,C and E, calcium, potassium, protein contributing to improve oral nutritional status. Moringa oleifera exhibits potent antioxidant activity attributed to its high content of polyphenols, flevanoids and vitamin C. These antioxidant helps combat oxidative stress, reduce immflamation and mitigate cellular damage, Theirby protective against chronic diseases such as cardiovascular disorders diabetes and cancer. Almost all parts from Moringa can be used as a source for nutrition with other useful values. This review elaborates an details of its health benifits.[1]

INTRODUCTION

Moringa oleifera is a small native tree of the sub-Himalayan regions of North West India, which is now indigenous to many regions in Arabia, southeast asia, the pacific and Caribbean Islands and South America. Among commoners, it has earned its name as ‘the miracle tree’ due to its amazing healing abilities for various ailments and even some chronic diseases. Several investigations were carried out to isolate bioactive compounds from various parts of

the plant due to its various applications. Moringa has been used to treat problem such as skin infection anemia, asthma, blackheads, blood impurities, bronchitis, catarrh, chest congestion, cholera and many other illnesses. Additionally, anti-inflammatory, anti-spasmodic, anti-hypertensive, anti-tumor, anti- oxidant, anti-pyretic, anti-ulcer, anti-epileptic, diuretic, cholesterol-lowering, renal, and hepatoprotective properties are present in Moringa oleifera. It is frequently discovered that moringa is utilized in a variety of health care goods, such as conditioners and moisturizers for the body and hair. It was also found that skin ointments containing moringa oil have been utilized since the Egyptian era. the moringa is "the most nutrient- rich plant yet discovered.[1] "Secondary metabolites such as alkaloids, tannins, flavonoids, steroids, saponins, coumarins, quinones, and resins are responsible for its therapeutic potential.[2]

Furthermore, Moringa oleifera has diuretic, anti-inflammatory, anti-spasmodic, anti-hypertensive, anti-tumor, anti-oxidant, anti-pyretic, anti-ulcer, anti-epileptic, renal, and hepatoprotective qualities. It is often seen that moringa is used in a range of health products, including body and hair moisturizers and conditioners. Additionally, it was discovered that skin ointments containing moringa oil have been used since the time of the Egyptians. They claim that moringa is "the most nutrient-rich plant yet discovered." Its medicinal efficacy is attributed to secondary metabolites such quinones, alkaloids, tannins, flavonoids, steroids, saponins, coumarins, and resins.

Although M. oleifera originated in Northern India, it is now widely spread over the Americas, Africa, Europe, Oceania, and Asia. This tree's leaves, blooms, pods, and seeds are valued as very nutritious food sources throughout Africa and neighbouring nations, especially in India, Pakistan, and the Philippines. The leaves can beeaten raw or cooked, and they can be kept for several months as an unrefrigerated dried powder without losing any nutritional value. These seeds are employed in water treatment stations for natural cleaning before undergoing additional cleansing procedures because they function as coagulants of organic materials suspended in water.

Malnutrition can be effectively treated using Moringa oleifera, a member of the Moringaceae family. Seven times more vitamin C than oranges, ten times more vitamin A than carrots, seventeen times more calcium than milk, nine times more protein than yoghurt, fifteen times more potassium than bananas, and twenty-five times more iron than spinach are all claimed to be found in moringa. Youngsters who aren't given enough breast milk frequently exhibit

signs of malnutrition. In order to increase milk production, breastfeeding moms are typically prescribed lactogogues. The phytosterol-based lactogogue functions as a precursor to the hormones needed for the development of reproductive organs. Hormone precursors, such as stigmasterol, sitosterol, and kampesterol, are abundant in moringa phytosterols.[3]

These substances raise the synthesis of estrogen, which in turn prompts the mammary gland ducts to proliferate and produce milk.[3] Regional names for the tree include benzolive, horseradish tree, drumstick tree, kelor, marango, mlonge, mulangay, saijihan, and sajna.[1] The Sanskrit name of Moringa oleifera *Mukhabhangah* Meaning face distorted by sickness.[2] Because practically every part of the moringa tree may be utilized for food, medicine, and industrial purposes,[4] it is regarded as one of the most useful trees in the world. A common tree in many tropical and subtropical nations is Moringa oleifera Lam. Furthermore, it has been observed that the leaves contain a variety of antioxidant components, including carotenoids, flavonoids, phenolics, andascorbic acid.[4]

Mbikay reviewed the medicinal potential of M. oleifera leaves in treating dyslipidemia and hyperglycaemia. Razis and associates Horseradish tree, Mulangay, Mlonge, Benzolive, Drumstick tree, Sajna, Kelor, Saijihan, and Marango are some more names for Moringa. According to scientific divisions, Moringa oleifera belongs to the following groups: Order: Brassicales; Class: Magnoliopsida; Division: Magnoliphyta; Kingdom: Plantae; Family: Moringaceae; Genus: Moringa; Species: M. oleifera.[1]

List of species

Moringa arborea Verdc. (Indigenous to Kenya)[6] Moringa borziana Mattei (Indigenous to Somalia)[6] Moringa concanensis Nimmo (Indigenous to northern India).[6]

List of species Moringa drouhardii Jum. – bottle tree (Indigenous to southwestern Madagascar)[6] Moringa hildebrandtii Engl. – Hildebrandt's moringa (indigenous to southwestern Madagascar)[6]Moringa longituba Engl. (Indigenous to Ethiopia and Somalia)[6] Moringa oleifera Lam. (Syn. M. pterygosperma) – horseradish tree (Indigenous to northwestern India)[6] Moringa ovalifolia Dinter & Berger (Indigenous to Namibia and Angola)[6] Moringa peregrina (Forssk.) Fiori[6] indigenous to Arabian Peninsula Horn of Africa and in the Southern Sinai, Egypt[6] Moringa pygmaea Verdc. (Indigenous to Somalia)[6] Moringa rivae Chiov. (Indigenous to Kenya and Ethiopia)[6] Moringa ruspoliana Engl. (Indigenous to Ethiopia)[6] Moringa stenopetala (Indigenous to Kenya and Ethiopia).[6]

Geographical distribution

Observations, field research, and availability were used to ascertain Moringa oleifera's distribution pattern. The coordinates (Latitude and Longitude) and height in several sites were detected using a Garmin Etrex GPS (Table 3). From the several ecological zones, pertinent data about the history, origins, and culture of numerous accessions were gathered. Since it is thought that Moringa oleifera is endemic and well-known in the northern part of Nigeria, information on the plant was initially obtained from regions in Southern Nigeria where Hausa settlers may be found. Researchers involved in the plant's studies at universities and research institutes were also contacted.

The Department of Biological Sciences at Covenant University in Ota received voucher specimens in the shape of leaves as herbarium specimens, and the seeds gathered were stored in the herbarium and seed repository. After carefully removing duplicates, accessions were grown in an experimental field at Covenant University in preparation for additional research.[11]

Cultivation Condition and Requirements

With an open canopy-shaped crown, moringa is a tiny, thin, rapidly growing deciduous shrub or tree that grows to a height of 9 to 15 meters. Although it grows well in a wide range of soil types, deep sandy loam soil with a pH of 6.5–8.0 is ideal for growing moringa, which has remarkable nutritional content and a number of therapeutic benefits. Typically, seedlings cultivated in nurseries or directly seeded in the field are used to plant M. oleifera. Temperature is the most significant environmental factor that influences plant growth and determines M. oleifera's natural geographic distribution, tree and shrub performance, physiology, and production.

Tropical and subtropical climates with hot summers and mild winters are ideal for M. oleifera cultivation, as studies have also demonstrated that a day/night temperature of 30/20 °C is the most favorable for germination, plant growth, and development. Temperature affects how well M. oleifera performs during its flowering stage, Lower temperatures (below 15 °C) cause a decreased rate of fruit growth during the flowering period, while temperatures between 30 and 35 °C encourage the creation of fruit. High temperatures are ideal for M. oleifera development, but suboptimal conditions can still result in modest but acceptable growth and a respectable yield.

M. oleifera can be successfully cultivated in cold climates to significantly enhance output; however, before planting, one should fully understand the implications of this type of farming.

The ideal annual precipitation range for M. oleifera, a plant species that thrives in high temperatures, is between 250 and 1500 mm. The metabolic pathways that regulate physiological functions including photosynthesis, growth, and respiration are impacted by temperature fluctuations and seasonal variations. Furthermore, seasonal variations have an impact on gas exchange. During summer, transpiration, stomata conduction, and the rate of photosynthesis all reduced, but there was an increase in the amount of CO2 uptake across the stomata. Under decreased rainfall and higher temperatures, M. oleifera plants decrease these features as an adaptive mechanism and increase water usage efficiency. This results from the plant's capacity to store carbon in its succulent sections when it is growing.[10]

The rate at which M. oleifera absorbs CO2 is twenty times greater than that of other plants. Furthermore, M. oleifera trees are extremely vulnerable to frost and other cold weather. When M. oleifera was cultivated in sandy soil and fertilized with NPK, the plant produced maximum growth, a high leaf yield, and good nutritional and biochemical characteristics. When treated with N at a rate of 521 kg/ha/year, M. oleifera can yield up to 27 tons of dry matter per hectare at a planting density of 167,000 plants/ha. Moreover, it appears that nitrogen fertilization modifies M. oleifera's chemical makeup by raising the amount of protein in the plant. To increase M. oleifera's selenium content, foliar spraying with selenium fertilizer has been used recently.[10] (Picture 1).

Plant Collection and Preparation

The plant leaves were gathered from Sedikong sa Lerato in Tooseng settlement Ga-Mphahlele, South Africa's Limpopo Province (24°26′57.10″S, 29°33′47.02″E). The region experiences about 300 mm of yearly rainfall and 15°C of average annual temperature. A voucher specimen (BM 01/2009) was developed and placed in the University of Fort Hare's Giffen Herbarium after the plant was authenticated at the Department of Botany. The leaves were picked while still green, allowed to air dry in the shade, and then ground into a powder using a Restch Cross Beater Mill SK 100 from Monitoring and Control Laboratories (Pty) Ltd. in Parkhurst, South Africa. The powder was then sieved through a 1 mm mesh screen. They were kept at room temperature (25°C) in black plastic containers that had been well-dried inside the storage.[5]

Nutritional composition determination

Using the Association of Official Agricultural Chemists (AOAC, 2005) methods, dried powdered Moringa leaves were evaluated for dry matter (DM), crude protein (CP), crude fat, calcium (Ca), magnesium (Mg), potassium (K), phosphorus (P), zinc (Zn), copper (Cu), iron (Fe), manganese (Mn), selenium (Se), and sodium (Na). The methods developed by Van Soest et al. (1991) were used to determine the amounts of neutral detergent fiber (NDF), acid detergent fiber (ADF), acid detergent lignin (ADL), acid detergent cellulose (ADC), and hemi-cellulose.

Condensed Tannins and Total phenolics determination

The butanol-HCl method Bate-Smith was used to perform calorimetric condensed tannins (CT) assays, with pure CT from Desmodium intortum serving as a reference standard. This process produces pink-colored anthocyanidins, which are detected at 550 nm, by oxidatively breaking down the interflavan bonds in alcoholic solutions at around 95°C in the presence of mineral acids. Calorimetric analysis was used to measure total phenolics in accordance with Price and Butler. Using this procedure, 6 ml of phenolics aqueous solution, 50 ml of distilled water, and 0.1 ml of ferric chloride were added. This was followed by the timed addition of 3 ml of ferricyanide solution (0.008 M).

After standing at room temperature for ten minutes, the absorbance at 720 nm was measured. As a blank, distilled water was utilized. The process oxidizes the phenolate ion and then uses an oxidation-reduction reaction to its advantage. Using a reagent containing potassium ferricyanide, the ferric ions are reduced to the ferrous state and subsequently identified through the production of the Prussian Blue complex (Fe4[Fe(CN)6)]3).[5]

Fatty acid profile determination

Using a Soxhlet extraction, the total lipids from the plant material were quantitatively extracted AOAC. While awaiting analysis, the extracted fats were kept frozen at -20°C in a polytop, a glass vial with a push-in top, covered in nitrogen. Using a disposable glass Pasteur pipette, 10 mg of the extracted lipids were placed into a screw-top test tube lined with Teflon. By methylating the extracted fat with methanol–BF3, fatty acid methyl esters (FAME) were made ready for gas chromatography. Using a Varian GX 3400 flame ionization GC and a fused silica capillary column, Chrompack CPSIL 88 (100 m length, 0.25 mm ID, 0.2 µm film thickness), fatty acid methyl esters were measured.[5]

The initial isothermic phase (40°C for 2 min) was used for the analysis. After that, the temperature was raised to 230°C at a rate of 4°C per minute. An isothermic phase lasting 10 minutes at 230°C finally ensued. With a split ratio of 100:1, fatty acid methyl esters in n-hexane (1 µl) were introduced into the column utilizing a Varian 8200 CX Autosampler. Both the injection port and the detector were kept at 250°C. Using nitrogen as the makeup gas and hydrogen as the carrier gas, the pressure was 45 psi. The chromatograms were recorded using Varian Star Chromatography Software.

By comparing the retention durations of FAME peaks in the samples with standards procured from Supelco (Supelco 37 Component Fame Mix 47885-U, Sigma-Aldrich Aston Manor, South Africa), fatty acid methyl ester samples were identified. Total saturated fatty acids (SFA), total monounsaturated fatty acids (MUFA), polyunsaturated fatty acids (PUFA), PUFA/SFA ratio (P/S), and n-6/n-3 ratio were among the fatty acid combinations and ratios that were computed. The analytical grade of all other reagents and solvents was acquired from Merck Chemicals (Pty) Ltd Halfway House in South Africa.[5]

Amino acid determination

An amino acid analyzer was used to determine the amino acids in the samples after they had been hydrolyzed with 6 M HCl for 24 hours at 100°C while under vacuum.[5]

Beta-carotene and vitamin E determination

The measurement of beta-carotene was conducted using the Thompson and Duval (1989) method as well as AOAC methods 974.29, 992.04, and 992.06.[5]

Nutritional composition

Science is now gradually confirming the amazing medical uses of moringa, which are asserted by numerous tribes and societies based on firsthand experience. Numerous vital nutrients, including vitamins, minerals, amino acids, beta carotene, antioxidants, anti-inflammatory substances, and omega 3 and 6 fatty acids, have been discovered through research to be present in moringa.

It is thought that moringa leaves are a rich source of protein, calcium, beta-carotene, vitamin C, and potassium. It functions as a potent natural antioxidant source. Because many types of antioxidant compounds, including carotenoids, phenolics, ascorbic acid, and flavonoids, are present.[4]

The Asian Vegetable Research and Development Centre (AVRDC) has reported that a number of its researchers have found that the leaves of four different species of Moringa are high in antioxidants and nutrients. The amount of these nutrients varies depending on the season, preparation technique, and leaf age. Most vegetables lose most of their nutrients when they are cooked, as is well known. Nonetheless, it was shown that the nutritional value of moringa leaves remained intact whether they were cooked, fresh, or dried and kept for months without refrigeration. Three times as much bioavailable iron was found in the boiling leaves as in the raw leaves. The effects were likewise observed using the powdered leaves of Moringa.[1]

In the tropics, it is utilized as a food source to combat malnutrition, particularly in young children and newborns.

M. oleifera is a veritable treasure trove of vital minerals and antioxidants. Minerals including calcium, potassium, zinc, magnesium, iron, and copper are abundant in M. oleifera leaves. M. Oleifera also contains vitamins such as beta-carotene, which is a form of vitamin A, vitamin B, which includes folic acid, pyridoxine, and nicotinic acid, and vitamins C, D, and E. According to study, immature pods have a protein content of about 20.66% and a fiber content of about 46.78%. Amino acid content is found in 30% of pods, 44% in leaves, and 31% in flowers. Similar concentrations of palmitic, linolenic, linoleic, and oleic acids were found in the immature pods and flowers.[1]

Moringa has lot of minerals that are essential for growth and development among which, calcium is considered as one of the important minerals for human growth. While 8 ounces of milk can provide 300–400 mg, moringa leaves can provide 1000 mg and moringa powder can provide more than 4000 mg. A good dietary intake of zinc is essential for proper growth of sperm cells and is also necessary for the synthesis of DNA and RNA. M. oleifera leavesshow around 25.5–31.03 mg of zinc/kg, which isthe daily requirement of zinc in the diet PUFAs are linoleic acid, linolenic acid and oleic acid; these PUFAs have the ability to control cholesterol.[1]

Table No. 1.1: Nutritional values present in leaves of M. oleifera.[2]

Nutritional Value	Dry leaf	Standard error
Moisture (%)	9.533	.194
Crude Protein	30.29	1.480
Fat (%)	6.50	1.042

Ash (%)	7.64	0.433
Neutral detergent fibre (%)	11.40	0.425
Acid detergent fibre (%)	8.49	0.348
Acid detergent lignin (%)	1.8	2.204
Acid detergent cellulose (%)	4.01	0.101
Condensed tannins (mg/g)	3.12	0.104
Total polyphenols (%)	2.02	0.390

Table no. 1.2: Amino acid of leaves, pods and seeds of M. oleifera.[2]

Amino Acids	Leaves	Pods	Seeds
Essential			
Arginine	0.4-1.8	0.36	4.5
Hitadine	0.1-0.7	0.11	2.3
lucine	0.4-2.2	0.65	6.7
lycine	0.3-1.4	0.15	1.5
Methionine	0.1-0.5	0.15	2.4
phenylalanine	0.3-1.6	0.43	4.0
threonine	0.1-1.3	0.39	3.1
Tryptophan	0.1-5.2	ND	1.6
valine	0.4-1.4	0.54	4.3
Non-Essential			
Alanine	1.8-3.0	ND	6.9
Aspartate	1.4-2.2	ND	5.0
cysteine	0.01-0.10	ND	2.0
Glutamate	2.5-2.5	ND	20.9
Glycine	1.3-1.5	ND	10.9
Proline	1.2-1.4	ND	4.5
Serine	1.0-1.2	ND	4.4
Tyrosine	0.01-2.60	0.08	1.6

Table No. 1.3: Micronutrients of leaves, pods and seeds of M. oleifera.[2]

Micronutrients	Leaves	Pods	Seeds
Minerals			
Calcium	440-3650	30.0-237.7	263.5
Magnesium	24-1050	9.6-83.4	78.4
Sulphur	137-925	137	ND
Sodium	164.0-272.1	210.5	ND
Potassium	259-20 616	259.0-2097.2	ND
Phosphorus	70-300	110.0-194.3	ND
Iron	0.85-126.20	4.4-15.5	44.8
Zinc	016-3.30	ND	ND
Copper	0.6-1.1	2.7-3.5	1.3
Vitamins			
A	6.78-18.90	ND	ND
B2	0.05-20.50	ND	ND
B3	0.8-8.2	ND	ND
B7	423	ND	ND

B12	0.06-2.64	ND	ND
C	17.3-220.0	ND	ND
E	77	ND	ND

Table No. 1.4: Nutrients present in various Parts of M. oleifera.[2]

Nutrients	Leaves	Pods	Seeds
Proteins	25.0-30.3	6.7-43.5	29.4-38.3
Lipids	0.1-10.6	0.1-5.1	3.8-41.2
Carbohydrate	0.1-43.9	0.1-38.2	0.1-21.1
Fiber	0.1-28.5	0.1-27.0	0.1-7.2

Phytoconstituents

The chemical composition of M. oleifera stems, leaves, flowers, pods, and seeds has been examined for the presence of bioactive compounds. The results show that secondary metabolites, which have pharmacological, nutritional, and/or antimicrobial properties, predominate and include phenolic acids, gallic acid, ellagic acid, chlorogenic acid, ferulic acid, glucosinolates, flavonoids, quercetin, vanillin, and kaempferol. But the concentration of these metabolites in M. oleifera extracts varies depending on soil type, climate, sun exposure, and geographic location. Furthermore, the chemicals extracted from the plant, mostly flavonoids and phenols, can have different contents depending on the extraction technique and solvents utilized.

Many phytoconstituents of M. oleifera have been isolated and studied, as shown in Table 1.4. The main phytochemicals obtained from the plant include: tannins, saponins, alkaloids, flavonoids, phenols and glycosides from leaves; tannins, steroids, flavonoids, alkaloids, glycosides, quercetin and terpenoids from flowers; gallic acid, catechins, epicatechin, ferulic acid, vanillin, caffeic acid, protocatechuic acid, cinnamic acid, phytosterol, quercetin, glycosides and phenols from seeds; procyanidins, aurantiamide acetate, 3-dibenzylurea, quercetin glycoside, rhamnoglucoside quercetin, and chlorogenic acid from roots; and procyanidin, sterols, triterpenoids, glycosides, tannins, alkaloids, b-sitosterol and octacosanoic acid from stem bark.

Table 1.5: Phytoconstituents and Their groups.

Sr. no.	Plant parts	Phytoconstituents	Group
1	Seeds	Beta-sitosterol	Phytosterol
2	Leaves, Stem and roots	4-alpha-L-rhamnopyroanosyloxy-benzylglucosinolate	Glucosinolate
3	Leaves, Seeds and roots	4-(alpha-L-rhamnosyloxy-benzyl) isothiocynate	Glucosinolate

4	Leaves	4-O-glucoppppyranosyl-caffeoyl quinic acid	Caffeoylquinic acid
5	Seeds	Glycerol-1-(9-octadecanote)	Glycoside
6	Seeds, Leaves, Stemand roots	Kaempferol	Flavanol
7	Leaves and seeds	Niazimicin	Glucoside
8	Leaves and seeds	Niazinin	Glucoside
9	Leaves	((alpha-L- rhamnosyloxy) benzyl) carbamate	Glucosinolate
10	Seeds, Leaves, stem and roots	Quercetin	Flavanol
11	Roots and flowers	Pterygospermin	Glycoside

Table no. 1.5

Nutrients	Fresh Leaves	Dry Leaves	Leaf Powder	Pods
Calories	92	329	205	26
Protein (g)	6.7	2904	27.1	2.5
Fat (g)	1.7	5.2	2.3	0.1
Carbohydrate(g)	12.5	41.2	38.2	3.7
Fiber	0.9	12.5	19.2	4.8
Vitamin B1(mg)	0.06	2.02	2.64	0.05
Vitaminb2(mg)	0.05	21.3	2.05	0.07
Vitaminb3(mg)	0.8	7.6	17.3	0.2
Vitamin C	220	15.8	113	120
Vitamin E	448	10.8	2003	-
Calcium(mg)	440	2185	68	30
Magnesium (mg)	42	448	204	24
Phosphorus (mg)	70	252	1324	110
Potassium(mg)	259	1236	0.57	259
Copper (mg)	0.07	0.49	28.2	3.1
Iron (mg)	0.85	20.6	870	5.3
Sulphur (mg)	-	-	870	137

Fig. 1

Fig. 2

Pharmacological uses

Recently, it was found that rats with liver fibrosis showed anti-fibrotic effects from the seed extract of Moringa oleifera. It had a strong protective effect against CCl4-induced liver fibrosis in rats, which was supported by histological observations and biochemical analysis of hydroxyproline, a biomarker of collagen deposition in the liver., Taking moringa supplements stimulates hepatoprotective effects against hepatocellular injury by preventing the rise of two serum markers of liver health: alanine aminotransferase (ALT) and aspartate aminotransferase (AST). Another study examined the impact of 50% ethanolic leaf extract of Moringa oleifera on stomach ulcers caused by aspirin, pylorus ligation, ethanol, and cold restraint stress.

All of these experiments' results showed that the 50% ethanolic leaf extract had dose-dependent anti-ulcerogenic activity, which reduced the ulcerogenic effect overall. It was discovered that the extract has ulcer-prevention qualities and reduced acid pepsin secretion.[1]

Anti-inflammatory effects

The plant has been shown to be useful in treating inflammation, hyperlipidaemia, and hyperglycaemia in both in vitro and in vivo investigations. The phytochemicals it contains, including as flavonoids and phenolic acids, have anti-inflammatory, anti-oxidant, and antibacterial characteristics.

The anti-fibrotic study revealed the hepatoprotective qualities of Moringa seed extract, which suggested that Moringa also had anti-inflammatory qualities against CCl4-induced liver damage and fibrosis. The reduction in serum globulin levels and liver myeloperoxidase activity supported this conclusion. Furthermore, a decrease in inflammatory cells in filtrations was found in the histological study.[1]

Anti-microbial effects

It has been shown that various extracts of Moringa's morphological parts, including the cotyledon, coat, stem bark, leaves, and root bark, have antibacterial potential (Arora et al. and Onsare et al. have recently published preliminary research on the antibacterial activity of aqueous extracts of pod husks against strains of yeast and Gram-negative pathogenic bacteria. According to Peixoto et al., their investigation revealed that the ethanolic and aqueous extracts of Moringa leaves showed encouraging potential as a remedy for specific bacterial illnesses. As observed in multiple other studies (Grosvenor et al.; Kudi et al.,; Awadh et al.,

the antibacterial activity of the moringa extract was found to be higher against gram positive species (S. aureus and E. faecalis) than against gram positive species (E. coli, Salmonella, P. aeruginosa, V. parahaemolyticus, and A. caviae).[1]

Anti-hyperglycaemic effects

Diabetes Mellitus (DM) is a long-term metabolic illness. Individuals with diabetes display a state of impaired glucose tolerance and persistent hyperglycaemia (Tiwari and Roa,. Because of its well-known pharmacological properties, moringa oleifera is used in traditional medicine to treat diabetes mellitus (Bhishagratna,; Babu and Chaudhuri,. Terpenoids, which seem to be involved in the activation of beta cells and the subsequent secretion of preformed insulin, may be the cause of the hypoglycaemic and anti-hyperglycaemic effect of Moringa oleifera leaves Tende et al.[1]

Anti-oxidant effects

Owing to their high polyphenol content, Moringa oleifera leaves have been shown to have antioxidant activity (Sreelatha and Padma,; Verma et al.,. Both mature and tender leaf extracts from Moringa oleifera demonstrate considerable antioxidant activity against free radicals, preventing key macromolecules from being oxidatively damaged, and providing a substantial level of protection against oxidative damage (Sreelatha and Padma), Mature Moringa oleifera leaf extract showed higher amounts of both enzymatic and non-enzymatic antioxidants, according to a comparative investigation. Additional thin-layer chromatography (TLC) analysis was carried out to determine the chemical makeup of active chemicals that may be responsible for these potential antioxidant protective attributes. Sreelatha and Padma state that both mature and young leaves contained trace levels of alkaloids, flavonoids, and phenolics as a result of a qualitative study of the extracts.[1]

Anti-tumor effects

In addition to reporting the efficacy of many isolates as anti-tumor promoters, the study sought to isolate various bioactive compounds from the Moringa oleifera Lam plant produced in the Philippines and investigate their anti-genotoxic and anti-inflammatory properties. One of these bioactive substances, niazimicin, was primarily shown by Guevara et al. to have an inhibitory effect on the two-stage mouse tumorigenesis process. Several test compounds, including 4-(alpha-L-rhamnosyloxy) benzyl isothiocyanate, niazimicin, and beta- sitosterol-3-o-beta-D-glucopyranoside, were found to be potent anti-tumor promotors based on the results of in vitro screening. While niazimicin demonstrated a 50% delay in the promotion of

tumours in the in vivo two- stage carcinogenesis testy on mouse skin, it also reduced the incidence of mice having papilloma's by 80% at 10 weeks and 17% at 20 weeks of promotion Guevera et al., Niazimicin was found to be a strong antitumour promoter in chemical carcinogenesis by thisinvestigation.[1]

Anticancer effects

A possible chemopreventive agent is Moringa oleifera Lam pod, according to a recent study by Budda et al. (2011). The incidence and multiplicity of tumours decreased with the dosage-dependent administration of boiled Moringa oleifera (bMO), particularly at the highest dose (6.0%) of bMO.[1]

Anti-clastogenic effects

The clastogenicity and anti-clastogenicity of Moringa oleifera pods have sparked renewed interest in recent years, demonstrating their potential health advantages. Because of its high vitamin C concentration, Moringa oleifera was discovered to have free radical scavenging properties, which directly imply anti-clastogenic benefits. This study's anti-clastogeniticity test shown efficacy against DMBA clastogens that act indirectly as well as direct mitomycin C (MMC) clastogens. In the end, it was determined that although bMO did not exhibit clastogenic effects at dosages of 2. 1, 4. 3, and 8. 5 g/kg BW, its anti-clastogenic capability is controlled by the direct acting carcinogenesis process.[1]

Table No. 1.5: Pharmacological Activity of different Parts of M. oleifera.[2]

Plant part	Pharmacological activity
Leaves	Antiatherosclerotic
	Anti-inflammatory
	Anticancer
	Antimicrobial
	Antioxidant
	Hepatoprotective
	Hypocholesterlemic
	Hypoglycemic
	Hypolipidemic
	Immunomodulatory
	Nephroprotective
	Neuroprotective
Roots	Anti-inflammatory
	Antimicrobial
	Hepatoprotective
	Nephroprotective
Flowers	Antimicrobial

	Hepatoprotective
	Nephroprotective
Pods	Anticancer
	Anti-inflammatory
	Antimicrobial
	Antioxidant
Seeds	Hypocholesteromic
	Anti-inflammatory
	Anti-cancer
	Antimicrobial
	Antioxidant
	Antitumor
	Immunomodulatory

Adverse effects

When consumed orally: Eating the leaves, fruit, and seeds of the moringa plant is mostly harmless. Short-term usage of moringa leaf and seeds as medication may be safe. Moringa leaf products have been around for up tosix months. Moringa seed products can be used for a maximum of three weeks. Root bark and moringa roots may be dangerous. Toxic chemicals can be found in the roots and root bark.

When rubbed upon the skin: F trustworthy information is lacking regarding the safety of moringa or its adverse effects.

Marketed formulation

Table No. 1.6: Marketed formulation.[9]

Sr. No.	Brand Name	Company Name	Dose	Pricing
1	Moringa Leaf Tablets	Saptamveda	240tablets (500mg)each	319/-Rs
2	Moringa Tea	TE-A-ME (Health Green Tea)	25pcs	151/-Rs
3	Oil (Moringa Oil)	Urbanorganics	100ml	244/-RS
4	Leaf Powder (Moringa Leaf Powder)	Attar Ayurveda	200gm	229/-Rs

Homemade remedies

Table No. 1.7: Homemade remedies.[8]

Sr. No.	Home Remedies	Ingredients	Procedure	Benefits/Uses
1	Moringa Juice	1. ½ cup Moringa Leaves or 1 tsp Moringa Powder Some ginger	1.Add Moringa Leaves, lemon, Ginger,Cinnamon powder into the	1. Boost Energy andImmunity Good for skin andhairs

			blender with little water and blend	
		3.1/2 tsp lemon	2.Add more water andblend again	3.Control DIABETES.
		4.1 cup water 5.1tsp honey (optional)6.1/2 tsp cinnamon	3.Filter it and juice is prepared	
2	Moringa Tea	1.Moringa leaves	1.2 Glass of water	1.Good for nervous system
		Water Honey	2.seperate the leaves and wash	2.Lower blood sugarlevels.
		4.1/2 lemon juice	3.Add Moringa leavesrolling boiling water	
			4.Wait for ½ minute cool it and sieve add honey and ½ lemon juice mix well.	

CONCLUSION

In summary, the results of the nutrient characterization of Moringa clearly show that the plant's leaves are nutrient-rich and have the potential to be a multipurpose feed addition. These include providing animal and human feed formulations with sources of protein, fatty acids, minerals, and vitamins. The dried leaves' high nutritional content is a significant nutritional indicator of the plant's potential value as a feed source. When feed is rare, drying the leaves helps to concentrate the nutrients, make it easier to conserve and consume, and allow it to be carried to places where it is not grown. The powdered form of moringa is advised for consumption.[5]

Therefore, it can be applied to enhance nutrition and health in sub-Saharan nations. The many medical and therapeutic benefits of the Moringa oleifera tree have been demonstrated in a number of instances. anti- inflammatory, anti-fibrotic, anti-microbial, and anti-cancer qualities. Additional research on the components and mode of action of the moringa plant could yield amazing potential for the creation of pharmaceutical medicines. The potential structural-activity link and the likely mechanism of action of the isolates should be the focus of future research because Moringa oleifera's chemical ingredients have been well studied and recorded. In conclusion, there are a lot of medical uses for Moringa oleifera.[1]

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