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A Pharmacognosy, Ethanobotany and Phyto-pharmacology of *Moringa oleifera* Lam.

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Abstract: *Moringa oleifera* is known for healthful and various restorative purposes have been valued for a really long time in many pieces of territory and presented ranges. *Moringa oleifera* is mostly present in a tropical and subtropical countries, it belongs to the *Moringaceae*. Various parts of these plant such as leaves, roots, seed, fruit, bark, flowers and immature pods has different pharmacological activity like an Abortifacient, Anticancer Activity, Anti-inflammatory activity, Anti-diarrheal, Anthelmintics, and Antitumor activity. In this review, we focused on Pharmacological Activity as well phytochemicals present in *Moringa oleifera*.

Keywords : *Moringa oleifera, Pharmacological actions, Phytochemistry.*

Running title: *A Pharmacognosy, Ethanobotany and Phyto-pharmacology of Moringa oleifera* Lam.

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INTRODUCTION:

Moringa Oleifera is a valuable medicinal plant, and phytochemical studies and isolated principles from it could be useful in developing lead compounds for the development of new herbal medications [1].The Moringa plant, which is native to tropical and subtropical regions, contains a unique combination of zeatin, quercetin, kaempferom, and other phytochemicals. It's significant because of its medical value. Various components of the plant, including the leaves, roots, seed, bark, fruit, flowers, and immature pods, have antitumor, antipyretic, antiepileptic, anti-inflammatory, and antiulcer properties [2].

Moringa oleifera is the most extensively farmed Moringaceae species.Horseradish tree, benzoil tree, kelor, marango, mlonge, moonga, saijhan, sajna, and ben oil tree are some of the names given to it. It is a fast-growing tree that is used all over the world. *Moringa oleifera* is one of the world's most useful trees, with medical, nutritional, and other beneficial characteristics in practically every component of the tree. Plant extracts are one of the most potential sources of novel medications, with promising outcomes in the treatment of diabetes, arthritis, and ulcers [2]. The term "Shigon" for M. oleifera appears in India's "Shushruta Sanhita," which was recorded in the first century AD. There is evidence that this tree has been cultivated in India for many thousands of years [3].

It belongs to the *Moringaceae* family and has around 13 species. It has been used as a traditional culinary item in India for approximately 5000 years. This plant thrives in hot, dry soil or humid tropical climates, growing to a height of 8 to 10 metres. It can withstand extreme climate variations and is not adversely impacted by draught.Drum stick tree, horse radish tree, mlonge, moonga, mulangay, kelor, marango, nebeday, saijhan, sajna, or Ben oil tree are some of the common names for this plant.Moringa is traditionally used as medicine in various parts of the world, according to ethnobotanical practise and literature, for the treatment of a variety of ailments [4].

GEOGRAPHIC ORIGIN AND DISTRIBUTION:

Moringa oleifera is a Himalayan plant that originated in the Himalayas [5]. India, Pakistan, Bangladesh, and Afghanistan are all home to this species [6]. It can be found in the Americas from southern Florida to Argentina, as well as on Caribbean and West Indian islands [7]. From Chenab to Oudh, the tree grows wild in the Sub-Himalayan region. It can be found at elevations ranging from sea level to 1400 meters. In Assam, Bengal, and peninsular India, it is widely grown near homes. It is a coppice in abundance [8].

MORPHOLOGY:

Moringa oleifera is a tiny, fast-growing evergreen or deciduous tree with a soft, white wood and corky, sticky bark that can reach a height of 9 meters. The flavor of the roots is similar to that of horseradish. Leaves are longitudinally cracked leaves with a 30-75 cm main axis and branch jointed main axis, glandular at joints, and glabrous and whole leaflets. Flowers in big auxiliary down panicles are white and perfumed, pods are pendulous and ribbed, and seeds are 3-angled. Tuberous taproot and brittle stem with corky bark characterize this tree. The leaves are pale green, compound, tripinnate, and 30-60cm long, with several tiny leaflets. When dried, the fruit pods are pendulous, green at first, then brown, triangular, and split lengthwise into three sections. The pods are 1 to 4 ft (30-120 cm) long and 1.8 cm (0.7 in) broad, with both ends tapering. The fleshy pith of the pods contains roughly 10 to 20 seeds [9]. Ovary superior, syncarpous, tricarpellary, unilocular with parietal placentation, stigma hairy, style slender, ovary superior, syncarpous, tricarpellary [10].

TAXINOMICAL CLASSIFICATION: [8]

Kingdom - Plantae

Sub kingdom - Tracheobionta

Super Division - Spermatophyta

Division - Magnoliophyta

Class - Magnoliopsida

Subclass - Dilleniidae
Order - Capparales
Family - *Moringaceae*
Genus - *Moringa*
Species – *Oleifera*

ETHANOBOTONY:

Abortifacient

The use of medicinal herbs as an abortifacient medicine is particularly common in rural areas. The knowledge of their antifertility properties is passed down through the generations. During our study work in one of the rural locations (Gora village, Raibarelli District, Uttar Pradesh), we discovered that over 80% of women use *Moringa oleifera* (also known as "Sahijan") to abort pregnancy in its early stages. The use of Moringa leaves as an abortifacient medication by Gora village women prompted us to investigate its antifertility properties more thoroughly. The work's comprehensive report is included. Ayurvedic Materica Medica plants recommend it for dysmennorhea, crysmanorhea, and ammenorhea [11].

Anticancer Activity

There are around 2.4 million incidences of cancer in India, and there are no known causes. The condition can be caused by a number of factors, including smoking, lack of exercise, and radiation exposure. Moringa has been proven in studies to be an anti-neoproliferative drug, slowing the proliferation of cancer cells. According to study, cancer's ability to produce reactive oxygen species in cancer cells may be responsible for its anti-proliferative action [12].

Anti – inflammatory activity

The American Type Culture Collection (ATCC) provided the marine macrophage RAW264.7 cells, which were grown at 37°C in DMEM media supplemented with 10% FBS and 1% penicillin-streptomycin in a humidified incubator containing 5% CO2. The Griess reagent procedure was used to measure nitrite generation [13].

Anti-diarrheal

Various medicinal plants have been claimed and utilized to treat diarrheal disorders in Ethiopia. *Moringa stenopetala*, which is commonly consumed as a vegetable in southern Ethiopia, is one of these plants in Ethiopian folklore medicine [14].

Anthelmintics

In 2010, there were 920 million caprine animals in the globe, with more than 90% of them in Asia and Africa. Labonne et al. counted 7 million goats in Cameroon, with half of the population residing in the Extreme-North Region. In tropical countries, parasitism by gastro-intestinal nematodes (GINs) is a major limitation to goat production [15].

Antitumor activity

Moringa Oliefera was identified as a possible source of anticancer chemicals in another investigation encompassing 11 plants used in Bangladeshi folk medicine. Utilizing tumor cell lines, the plant extract was tested for cytotoxicity using the brine shrimp lethality assay, sea urchin eggs assay, hemolysis assay, and MTT assay [16].

PHARMACOGNOSTIC STUDIES:

Using proper procedures, the entire seed was examined for morphological characteristics [17].These included measurements of the dried whole plant's size, shape, color, and margin, among other things. Sensory based features such as smell, taste, and others were used to conduct an organoleptic examination of the raw medication. Macroscopic characters like appearance, taste, color, and odor were evaluated. Leaf sections were cut by free hand sectioning and numerous sections were examined microscopically [18].

Transverse hand-cut chunks were taken and stained to make them permanent. The permanent preparations were quantified, and photomicrographs were obtained. Astage and an ocular micrometre were used to measure the contents of the cells [17]. Free hand sectioning was used to cut bark sections, and multiple sections were studied microscopically. To reveal lignified components, histochemical experiments were performed using hydrochloric acid-phloroglucinol. ruthenium red for mucilage, iodine-iodide for starch, Sudan Ill for lipophilic lipophilic compounds, Dragendorff's reagent for alkaloidal components For phenolic compounds, ferric chloride is used, and silver nitrate is used for isothiocynate glycosides [19]. The cell composition was studied histochemically by staining hand cut sections with various reagents [20]. The dried powder of seeds was treated with a chloral hydrate solution, and then stained with 1% safranin for 5-10 minutes before being mounted in 50% glycerine**.** Alcohol and water were used to extract a known amount of dried powder. Different ingredients of these extracts we evaluated [17].

FIG 1: *Moringa oleifera* Root

PHYTOCHEMISTRY:

Moringa oleifera roots contain large levels of 4-(-L-osyloxy)-benzylglucosinolate and benzylglucosinolate [21].

Moringa oleifera is high in compounds containing rhamnose, a simple sugar, as well as glucosinolates and isothiocyanates, a rather unusual group of chemicals. Moringine and moringinine, two alkaloids found in the bark, have been reported [9].

Aurantiamide acetate 4 and 1, 3-dibenzyl urea 5 were extracted and described from *Moringa oleifera* roots. For the first time, both of these chemicals were isolated from this genus [21].

The stem of *Moringa oleifera* was used to isolate vanillin, -sitosterol, -sitostenone, 4-hydroxymellin, and octacosanoic acid. Purified, sweet, non-desiccating oil of high quality, commonly marketed as "Ben oil" [9].

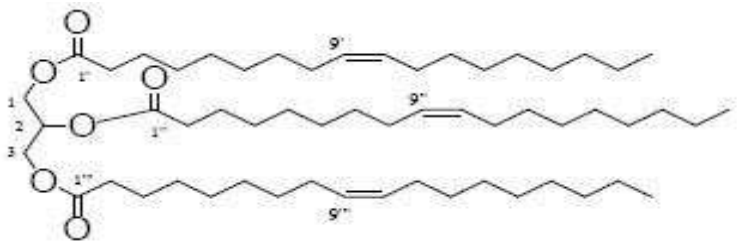
Phytochemicals are chemicals produced by plants in the purest sense of the term. However, the term is commonly used to refer to only those chemicals that may have an effect on human health or on plant flavour, texture, fragrance, or colour, but are not required by humans as necessary nutrients. Examining the phytochemicals of *Moringa* species allows researchers to look at a variety of unusual compounds [22].

When *Moringa Olifera* seeds, leaves, and roots were broken down, glucosinolates and phenolics were discovered, but no anthocyanidins or proanthocyanidins were discovered [23].

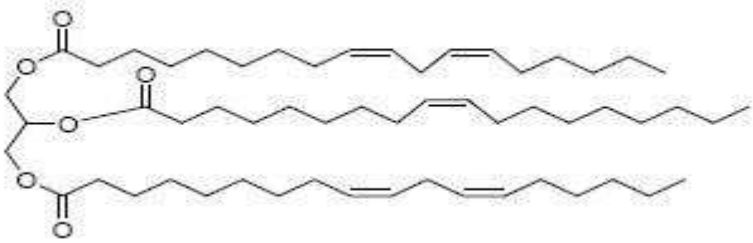
Purified whole-gum exudate from *Moringa oleifera* was discovered to contain L-arabinose, -galactose, -glucuronic acid, and L-rhamnose, -mannose, and -xylose, while mild hydrolysis of the entire gum with acid yielded a homogenous, degraded-gum polysaccharide consisting of L-galactose, -glucuronic acid [24].

Nine amino acids, sucrose, D-glucose, traces of alkaloids, wax, quercetin, and kaempferat are found in the flowers, while the ash is high in potassium and calcium. They've also been found to contain alkaloids, kaempherol, rhamnetin, isoquercitrin, and kaempferitrin, among other flavonoid pigments [23].

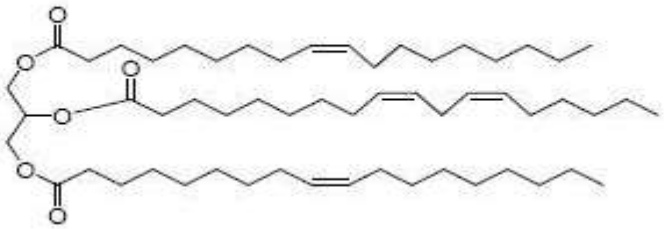
There's also quercetin-3-O-glucoside and quercetin-3-O-(6''-malonyl-glucoside) in the leaves, as well as kaempferol-3-O-glucoside and kaempferol-3-O-(6''-malonyl-glucoside), 3- caffeoylquinic acid, and 5-caffeoylquinic acid in smaller concentrations. Ndong et al. used HPLC analysis to identify significant polyphenols in *Moringa oleifera* powder, including quercetin glucosides, rutin, kaempferol glycosides, and chlorogenic acids [24].



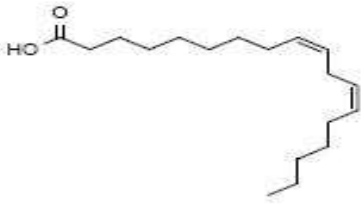
1, 2, 3 – triolein



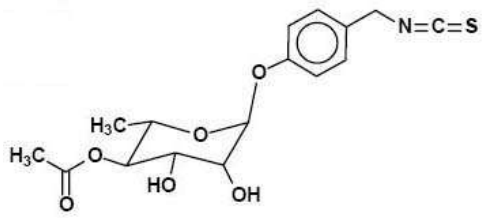
1, 3 – dilinoleoyl-2-olein



1, 3-dioleoyl-2-linolein



Linoleic acid



4-(4'-O-acetyl-α-L-rhamnopyranosyloxy) benzyl isothiocyanate

PHARMACOLOGY :

Antibacterial and Antifungal Efficacy

The distillate of M. oleifera significantly reduced the growth of test microorganisms, indicating that it has antibacterial properties. E. coli, followed by S. aureus, K. pneumoniae, P. aeruginosa, and B. subtilis, showed the most inhibition among the microorganisms studied [25]. Fungi inhibition was also found in the form of lower colony diameter in distillate-poisoned plates compared to control plates. Following A. niger, A. oryzae, A. terreus, and A. nidulans, A. oryzae, A. terreus, and A. nidulans were shown to have the most inhibition [26]. The essential oil percentage of the plant material found in the distillate fraction could be responsible for the antibacterial and antifungal properties of *Moringa oleifera* steam distillate [27].

Anti-Oxidant Effect

The presence of phenolic chemicals in Moringa may explain its antioxidant properties, which were validated by phytochemical screening of the hydro-ethanolic extract. Moringa pods contain glucosinolates, isothiocyanates, thiocarbamates, and flavonoids, which are all essential bioactive chemicals in this regard. These chemicals reduce reactive oxygen species (ROS), chelate metal ions, and replenish membrane-bound antioxidants [28]. Leaves have been discovered to be a source of natural antioxidants [29].

Gastric Ulcer Protective Activity

In two animal models of ulcers, Das et al. investigated the possible antiulcer effects of aqueous extracts of *Moringa oleifera*. In pyloric ligation and ibuprofen-induced stomach ulcer models, the aqueous extract of leaves was investigated for antiulcer efficacy at doses of 200 mg and 400 mg/kg p.o. The severity of stomach ulcers in both animals was determined using the ulcer index mean. In a dose-dependent manner, the aqueous extract of *Moringa oleifera* leaf was proven to protect rats from developing stomach ulcers caused by indomethacin. Tannins, with their protein precipitating and vasoconstriction properties, may be useful in avoiding ulcer formation [30].

Tannins, as an astringent, may have precipitated microproteins at the ulcer site, generating an impermeable protective pellicle over the lining to shield it from poisonous substances and proteolytic enzyme attack. Flavonoids have also been shown to protect against ulcer development by enhancing capillary resistance and improving microcirculation, making cells less susceptible to precipitating stimuli **[**31].

Wound Healing Activity

The wound healing efficacy of an aqueous extract of M. oleifera leaves was examined. The extract was tested in rats' utilizing incision, excision, and dead space wound models at doses of 300 mg/kg body weight. Increased collagen deposition, as well as better alignment and maturation, appear to be responsible for the prohealing effects. Based on the findings, it can be inferred that M. oleifera aqueous extract possesses significant wound healing properties [32].

Antitumor Activity

Moringa oleifera has a variety of bioactive chemicals that have anticancer properties. These include niazimicin, which inhibits tumour promoter teleocidin B-4-incited Epstein-Barr Virus activation, and thiocarbamate, which has been touted as a powerful anticancer agent [33].

Antidiabetic Activity

Both Type 1 and Type 2 diabetes have been shown to be cured by *Moringa Oliefera*.Moringa has been shown to have anti-diabetic properties in many studies. In rats, the aqueous extract of *Moringa Oliefera* can cure streptozotocinin-induced Type 1 diabetes and insulin-free Type 2 diabetes. In a separate study, scientists fed Moringa seed powder to STZ-induced diabetes mice and observed a decrease in fasting blood glucose levels [34].

Cosmetic use

Ben oil, also known as Behan oil, is extracted from MO seeds and is commonly used as carrier oil in cosmetics. It's still used in perfumes and as watch oil [35].

Antiasthmatic Activity

Alkaloids found in the Moringa plant work similarly to ephedrine and can be used to treat asthma. Bronchioles are unwound by these alkaloids. Bronchial asthma can be effectively treated with *Moringa oleifera* seed kernels, which also improve respiratory capacity [36].

Blindness And Eye Infections

Moringa oleifera seeds contain a significant amount of Vitamin A, which helps to prevent eye problems in children and night vision impairment .*Moringa oleifera* juice can also help with conjunctivitis [37].

Antihypertensive Activity

*Moringa oleifera*juice has a consistent effect on blood pressure [38]. Mustard oil glycosides, thiocarbamate glycosides, and nitriles are found in *Moringa oleifera* leaves, which can lower blood pressure.[39]

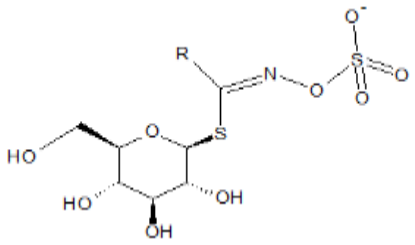
Analgesic Activity

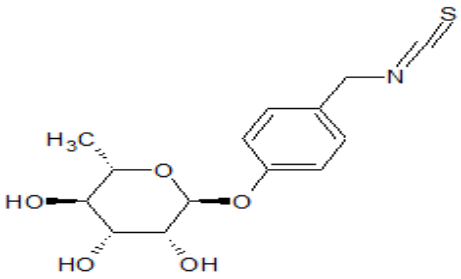
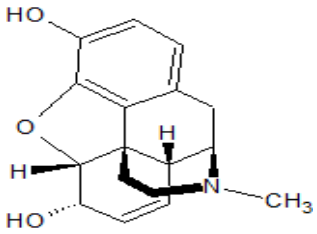
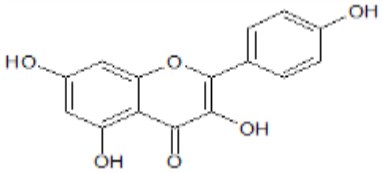
Moringa oleifera has been identified as having analgesic properties [40]. The analgesic activity of Moringa was confirmed using a hotplate and tail immersion technique delivered using an alcoholic extract of *Moringa oleifera* leaves and seeds [41].

Larvicidal and Pupicidal Activity

Moringa oleifera seed methanolic extract contains particular phytochemicals that are efficient mosquito vector control agents [42].

Table 1: Phytochemical Compounds In Various Parts And Their Structures with Properties [43]

Plant parts	Chemical structure	Properties
Leaves	 Glucosinolates	Chemopreventive activity by activating apoptosis

Seeds	 4-(α-L-rhamnosyloxy)benzyl isothiocyanate	Anti-tumor enhancer, antimicrobial
Root bark	 Morphine	Anti-inflammatory activity, antiulcer
Flowers	 Kaempferol	Prevent carcinogenesis and inhibit mutations, inhibit production

CONCLUSION:

Moringa oleifera is indeed a very useful breakthrough in the demand of alternative natural medicine for the treatment of various disease activities by pathogenic organisms. The plant could be used to treat typhoid fever, diarrhoea, stomach ulcers, tumours, postmenopausal syndrome, arteriosclerosis, blood sugar control, anti-inflammatory medications, gastrointestinal disorders, anti-oxidants, cancer, diabetes, and other diseases. The medicinal plant *moringa oleifera* is listed in the hierarchy of medicinal plants used to cure microbial diseases. *Moringa oleifera* is recommended for use in the manufacture of antimicrobial medications because of its antibacterial action and phytochemical composition. The active ingredients will be separated and formulated into appropriate dosage forms and delivery system in the future. In the future, in-vivo investigations using animal models may be conducted for a better result.

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