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Ethnopharmacological Review Of Drum Stick (*Moringa Oleifera*): Prevalently Used As An Alternative Medicine.

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ABSTRACT

Moringa oleifera, or the horseradish tree, is a pan-tropical species that is known by such regional names as benzolive, drumstick tree, kelor, marango, nébéday, saijhan, and sajna. Over the past two centuries, many reports have appeared in scientific journals describing the nutritional and medicinal properties of it. Its utility as a non-food product has also been widely explained it is used as lumber, charcoal, water clarification, lubricating oil. Different parts of the plant contains essential minerals and are a good source of protein, vitamin, amino acids and various phenolic compounds. It has more than 40 natural anti-oxidants. Moringa has been used by ancient kings and queens in their diet for mental alertness and healthy skin. The leaves, pods, seeds, gums, barks and flowers of Moringa are used in more than 80 countries to relieve mineral and vitamin deficiencies, support a healthy cardiovascular system, promote normal blood-glucose levels, neutralize free radicals {thereby reducing malignancy}, provide excellent support of the body's anti-inflammatory mechanisms, enrich anaemic blood and support immune system. It also improves eyesight, mental alertness and bone strength. It has potential benefit in malnutrition, general weakness, lactating mothers, menopause, depression. There is a need to explore therapeutic, nutritional and benefit of this gift of nature reported to be one of the world's most useful tree. The present review is intended to create public awareness regarding benefits of an edible plant Moringa which is also known as miracle tree so they may inculcate it in their daily diet.

Keywords: Moringa, traditional uses,, benefits, nutritional value, therapeutic use.

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INTRODUCTION

Moringa oleifera is the most widely cultivated species of a monogeneric family, the Moringaceae, that is native to the sub-Himalayan tracts of India, Pakistan, Bangladesh and Afghanistan. This vast-growing tree which is also called as the horseradish tree, drumstick tree, benzolive tree, kelor, marango, mlonge, moonga, mulangay, nébéday, saijhan, sajna or Ben oil tree .It is already an essential crop in India. All parts of the Moringa tree can be consumed . Moringa seed oil (yield 30-40% by weight), also known as Ben oil, is a sweet non-sticking, non-drying oil that can resist rancidity. It has been used in salads, also for fine machine lubrication, and in the manufacturing of perfume and hair care products. The leaves and buds of the plant are used as vegetable and can be rubbed on the temples for relieving headache while root and root bark are regarded as anti scorbutic and can be used externally as counterirritant [1]. The eye diseases are treated with the juice of the leaves with honey [2]. The plant is also known to possess high nutritional value and is used in a folklore medicine to treat various ailments related to pain and inflammation [3]. Dried seeds of *Moringa oleifera* are used in ophthalmic preparation, venereal affection anti-inflammatory, purgative and as tonic. The alcoholic extract of the leaves of *Moringa oleifera* are reported to have analgesic activity [4] and the aqueous extract of *Moringa oleifera* roots also shows antifertility profile [5]. The plant is reported to possess wide range of pharmacological effects that include antitumor [6], antispasmodic, diuretic [7], antiulcer [8], hypotensive [9], hypolipidemic [10], Hepatoprotective [11], antifungal [12] and antibacterial activities [13]. The purpose of this review is to summarize the pharmacological properties of different parts of the plant, *Moringa oleifera*.

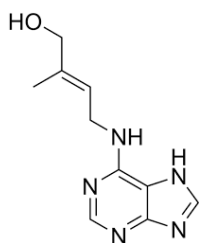


Fig.1-zeatin

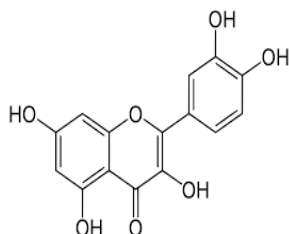


Fig.2-quercetin

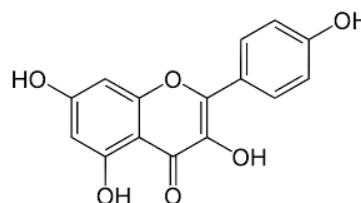


Fig.3-kaempferol

NUTRITIONAL VALUE OF DRUMSTICK

Moringa is rich in nutrition owing to the presence of a variety of essential [phytochemicals](#) present in its leaves, pods and seeds. In fact, moringa contains vitamin c , vitamin A , calcium , protein, potassium and iron [1]. The fact that moringa can be easily grown makes it a sustainable remedy for malnutrition. Countries like Senegal and Benin treat children with moringa [2]. Children deprived of breast milk tend to show symptoms of malnutrition. Moringa is rich in phytosterols like [stigmasterol](#), [sitosterol](#) and kampesterol which are precursors for hormones for reproductive health. These compounds increase the [estrogen production](#), which in turn stimulates the proliferation of the [mammary gland](#) ducts to produce milk. It is used to treat malnutrition in children younger than 3 years [3]. About 6 spoonfuls of leaf powder can meet a woman's daily iron and calcium requirements, during pregnancy. This provides an overview on the [nutritional values](#), medicinal properties and pharmacological properties of *Moringa oleifera*.



SOIL CONDITIONS NECESSARY FOR PLANTATION

Moringa oleifera can be grown in any tropical and subtropical regions of the world with a temperature around 25–35 °C. It requires sandy or loamy soil with a slightly acidic to slightly alkaline pH and a net rainfall of 250–3000 mm [4]. *Moringa oleifera* differs in nutrient composition at different locations [5]. The tree grown in India has slightly different nutritional components than a tree grown in Nigeria. Studies have shown the nutritional differences in the leaves from two ecological locations semi-deciduous and Savannah regions [6]. It showed that the later was less nutritious than the former and attributed this to high temperatures at the Savannah regions. At higher temperature, proteins and enzymes get denatured and this could be the cause for the difference in nutrient content. Soil is an important factor that defines nutrient content and strength of the plant. Studies have been conducted in the past that showed that fertilizers when applied solely or in combination with others resulted in different nutrient compositions on plant parts [7]. NPK (nitrogen, phosphorus and potassium) fertilizer, poultry manure and organic base fertilizer was provided to study the effect on the nutrient content and found that poultry manure gave the best results than phosphorous, potassium, sodium and manganese. Likewise the stem growth and vegetative growth of *Moringa oleifera* increased on application of poultry manure.



MEDICINAL PROPERTIES OF MORINGA

Moringa oleifera is often referred as a panacea and can be used to cure more than 300 diseases. Moringa has long been used in herbal medicine by Indians. The presence of phytochemicals makes it a good medicinal agent and an alternative source of medicine for people around the world.

MORINGA AS AN ANTI-CLASTOGENIC AGENT

In recent years, there has been a new interest in the clastogenicity and anti-clastogenicity of *Moringa oleifera*. The results from a study by [8] showed that bMO did not possess any clastogenic activity in mice upon consuming a diet consisting of 1.5%, 3.0% and 6.0% of dietary fibres. The *Moringa oleifera* demonstrated free radical scavenging properties that directly indicate anti-clastogenic effects which was found to be due to its rich vitamin C content. The anti-clastogenicity test in this study showed activity against both direct mitomycin C (MMC) and indirectacting DMBA clastogens. It was finally concluded that bMO at 2, 1, 4, 3 and 8. 5g/kg BW doses did not show clastogenic effects while its anti-clastogenic potential is modulated by the direct acting carcinogenesis process.

MORINGA FOR IT'S NEUROPROTECTIVE POTENTIAL

The neuroprotective effects of *Moringa oleifera* are an important area of study. It has been studied that aqueous and hydroalcoholic extracts of *Moringa oleifera* leaves increase the cognitive activity, besides acting as neuroprotector in mice with colinotoxin induced dementia [9,10] Reduced levels of brain lipid peroxidation and increased levels of superoxide dismutase and catalase were observed when leaf extract was given [9]. In addition, another study has demonstrated the neuroprotective properties of an ethanolic extract of *Moringa oleifera* leaves, when administered with a primary culture of hippocampal neurons. The extract promoted neurite outgrowth with significant increase in the number and length of dendrites and axonal branches [10]. These results shows that *Moringa oleifera* may be used as neuoprotective agent by reducing oxidative stress.

HEPATO AND NEPHRO PROTECTIVE POTENTIAL OF MORINGA

Moringa oleifera leaves play an important role in the reduction of liver and kidney drug-induced damage in animals. For example, studies have shown the hepato and renal-protective properties of *Moringa oleifera* against various drugs, such as gentamicin, pyrazinamide, rifampicin, isoziazide and acetaminophen, which are mainly attributable to its leaves [12-15]. It was also observed that a reduction in serum levels of alanine aminotransferase, aspartate aminotransferase, alkaline phosphatase [12], urea and creatinine [12] occurred in animals treated with *Moringa oleifera* leaf extract. These were confirmed by various histological tests, which showed reduction of drug-induced hepatic and renal damage in animals treated with *Moringa oleifera* leaves. Also, aqueous and alcoholic root and flower extracts of *Moringa oleifera* have been reported to have hepatoprotective activity against the effects of acetaminophen, reducing serum transaminases (alanine aminotransferase and aspartate aminotransferase), alkaline phosphatase and bilirubin levels [16]. This activity also increases the recovery of cadmium-induced hepatotoxicity in rats [12]. further studies are still required to better explain the pharmaceutical importance of *Moringa oleifera* as hepato and nephro protective agent.

MORINGA AS AN ANTI-INFLAMMATORY AGENT

The anti-inflammatory activity of *Moringa oleifera* has been identified after treatment with extracts of various parts of the plants like roots, stems, leaves, flowers, pods and seeds. In a study with rats, *Moringa oleifera* root extract decreased the development of paw edema, with results same as that of phenylbutazone, a nonsteroidal anti-inflammatory drug with analgesic and antipyretic properties [17]. Further, the butanol extract of *Moringa oleifera* seeds decreased and stopped the acetylcholine-induced bronchospasms and airway inflammation in guinea pigs [18]. also, a clinical study with patients with mild to moderate asthma demonstrated that *Moringa oleifera* dried seed powder showed improved results by increasing the forced vital capacity, forced expiratory volume and peak expiratory flow without adverse reactions and effects [19]. Many bioactive compounds may be involved in the anti-inflammatory properties of *Moringa oleifera*, such as quercetin, which appears to inhibit the activation of NFkB, which is an essential step to unchain the inflammatory process [58]. Also many compounds in *Moringa oleifera*, such as flavonoids and phenolic acids, are involved in the anti-inflammatory activity of this plant. It has also been reported that *Moringa oleifera* leaf extract and quercetin regulate the expression of iNOS, IFN-g and C-reactive protein and decrease TNF-a and IL-6 release, in rats [58]. A similar result was found for isothiocyanates which was obtained from *Moringa*

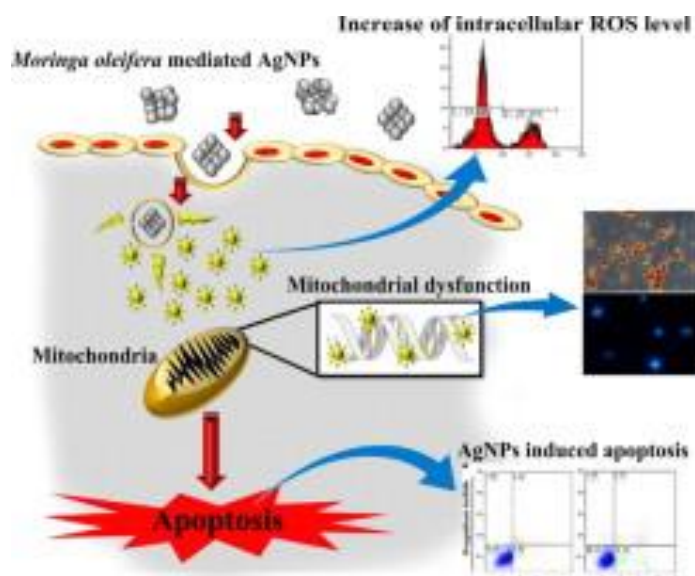
oleifera leaves, which decreased the production of pro-inflammatory mediators by RAW macrophages, especially IL-1b, iNOS, TNF-a and NO [16]

IMMUNOMODULATORY PROPERTY OF MORINGA

The immunomodulatory effects of *Moringa oleifera*, it has been shown that the ethanolic *Moringa oleifera* leaf extract reduced cyclophosphamide-induced immunosuppression in rats and also stimulated cellular and humoral immunity

MORINGA FOR IT'S ANTI-CANCER POTENTIALITY

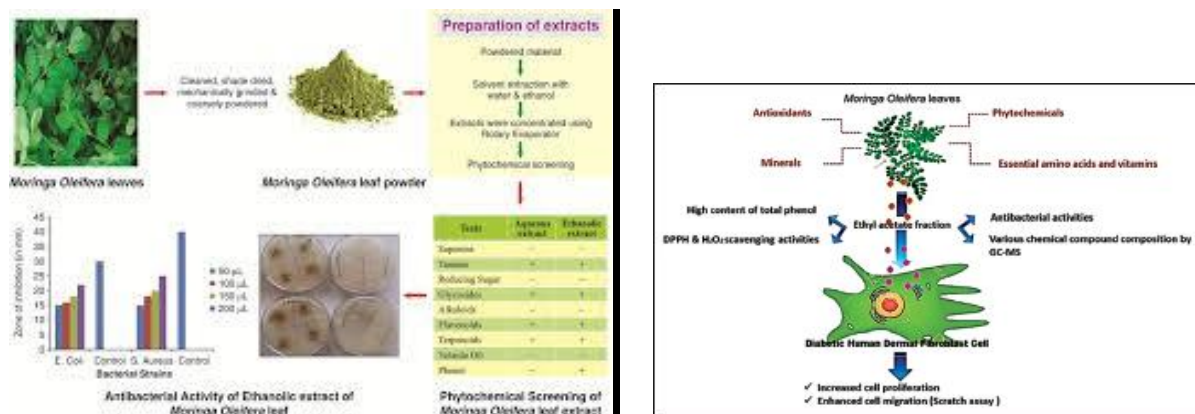
There are a few in vitro studies to evaluate the anticancer potential of *Moringa oleifera* . However, the existing results suggest the potential anticancer properties of *Moringa oleifera*. One of the first studies on *Moringa oleifera* antitumor effect was performed with compounds obtained from its ethanol seed extract, showing that the compounds which are present in it are potent tumor inhibitors [21]. Dichloromethane and methanolic *Moringa oleifera* leaf extracts present in vitro anticancer activity against human hepatocellular carcinoma, colorectal adenocarcinoma and breast adenocarcinoma, with no toxic effects on human fibroblasts [22]. Other studies shows the effects of oral administration of hydromethanolic and methanolic *Moringa oleifera* leaf extracts on a mouse melanoma model. The study shows that the oral administration of the extract delayed tumor growth due to hich the lifespan of the mouse increased significantly. [23]. These anticancer properties may be because of presence of the bioactive compounds which occur in the extracts, such as the hexadecanoic acidethyl ester [24].



ANTI-MICROBIAL POTENTIAL OF MORINGA

Many *in vitro* studies have shown the inhibitory activity of *Moringa oleifera* root, stem, leaf, flower, pod and seed extracts on Gram-positive (*Enterococcus faecalis*, *Staphylococcus epidermidis*) and Gram-negative bacteria (*Salmonella enterica*, *Pseudomonas aeruginosa*, *Escherichia coli*) isolated from clinical samples [25-29]. The antimicrobial effect of the crude extracts on *E. coli* and *K. pneumoniae* strains are compared to that of the antibiotic streptomycin . The *in vitro* antibacterial potential of *Moringa oleifera* has been also given against other bacterial species. This potential is due to the biocompound benzyl-isothiocyanate which inhibits bacterial growth by disrupting the mechanisms of membrane and enzyme synthesis [30]. Also the antibacterial activity of *Moringa oleifera* extracts is also because of the presence of gallic acid and tannins[31], and saponins, tannins, isothiocyanates and phenolic compounds, such as alkaloids and flavonoids, which have inhibitory activity [28,32,33]. many studies have resulted the antifungal activity of *Moringa oleifera* seed extracts against *Rhizopus* ; pod extracts against *Alternaria sp.*, *Colletotrichum sp.*, *Candida albicans* and *Fusarium sp*; and root extracts against *C. albicans* and *Aspergillus flavus* [20,25,26]. Other fungal species are also susceptible to *Moringa oleifera* seed and leaf extracts, such as the dermatophytes, ,

rubrum, Trichophyton Trichophyton, mentagrophytes, Epidermophyton floccosum and Microsporum canis which were isolated from clinical samples [32], as well as Candida species, such as C. famata, C. tropicalis and C. ciferri isolated from prawn farming [41]. M. canis isolated from cases of feline dermatophytosis, as well as C. albicans from the oral microbiota of dogs were also susceptible to flower and seed extracts [41,42]. The antifungal activity of this essential oil was because of polyphenols, hydrocarbons, hexacosane, pentacosane, heptacosane, phytol and thymol [37]. Moreover, flavonoids and the compounds pyterigosperrin and isothiocyanates obtained from seeds and leaves of Moringa also shows antimicrobial activity [36,32,33]



ANTI-DIABETIC POTENTIALITY

Many medicinal plants have been studied for their potential as therapeutic agent for diabetes. *Moringa oleifera* is also an important plant of this category. *moringa oleifera* leaves decreased blood glucose concentration in Wistar rats, modeled type 2 diabetes [43]. Another study shows that the extract from Moringa leaf is effective in reducing blood sugar levels within 3 h after taking [44]. For antidiabetic activity of *Moringa oleifera* it has been indicated that dark chocolate polyphenols [45] and other polyphenols [46] are responsible for hypoglycemic activity. Moringa leaves are potent source of polyphenols, including, rutin, kaempferol glycosides, and other polyphenols [43]. Thus, Moringa can be used as anti-diabetic agent in coming years.

ANTI-VIRAL POTENTIAL OF MORINGA

The antiviral potential of ethanol extract of *Moringa oleifera* seeds was reported [21,38]. In addition, hydroalcoholic leaf extracts of *Moringa oleifera* inhibit hepatitis B virus replication [83], and silver nanoparticles synthesized from *Moringa oleifera* seed extract which acts as the reducing and stabilizing agents that have inhibitory activity against dengue virus type 2 [40]. The biocompounds associated with antiviral activity are isocyanate and niaziminin [21]. *Moringa oleifera* have only few study reports on its anti-viral property.

IN OCULAR DISEASE

Vitamin A deficiency is a major cause of blindness, *Moringa oleifera* leaves and pods and leaf powder which contain high proportion of vitamin A. Ingesting drumstick leaves with oils can improve vitamin A nutrition and can delay the development of cataract [47]. The use of *Moringa oleifera* as a supplementary food was highly accepted for its potential as vitamin A source [48]

ANTI-PYRETIC EFFECT OF MORINGA

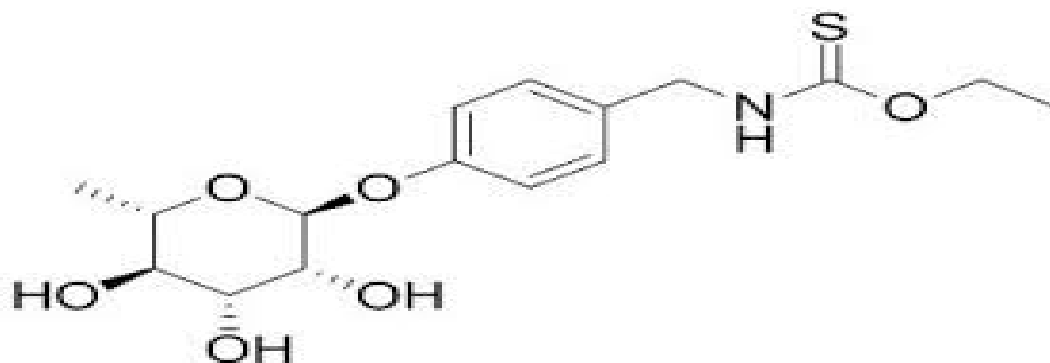
As a result of anti-inflammatory action of Moringa bioactive constituents, the antipyretic activity can be assumed. A study was conducted to see the antipyretic effect of ethanol, petroleum ether, solvent ether and ethyl acetate extracts of *Moringa oleifera* seeds using yeast induced hyperpyrexia method. Paracetamol was used as control during the study. Not surprisingly, ethanol and ethyl acetate extracts of seeds showed significant antipyretic activity in rats [49]

ANTISPASMODIC AND ANTIULCER EFFECTS OF MORINGA

Moringa root and leaves contain several compounds with spasmolytic activity. The spasmolytic activity of different constituents of the plant support for traditional uses of this plant in gastrointestinal motility disorder [50]. *Moringa oleifera* methanolic extract is also used in protecting experimental rats from gastric lesions induced by acetylsalicylic acid, serotonin and indomethacin. In addition, it also enhances healing process of chronic gastric lesions which were induced by acetic acid in experimental animals [51,52].

ANTI-TUMOR ACTIVITY OF MORINGA

Moringa oleifera is a potent anticancer plant because of various bioactive compounds with significant antitumor activity which have been discovered from *Moringa oleifera*. From various bioactive compounds from *Moringa oleifera*, niazimicin, was found to have anticancer activity [53]. Niazimicin also shows the inhibition of tumor promoter [54]. Another study involving 11 plants used in Bangladeshi folk medicine, *Moringa oleifera* was considered as potential source of anticancer compounds. During this study, the plant extract were studied for cytotoxicity through brine shrimp. The study also indicated the potential cytotoxic effects of *Moringa oleifera* leaf extract on human multiple myeloma cell lines [55,56]. Beside leaves, *Moringa oleifera* seed extracts also have anticancer activity through its effects on hepatic carcinogen metabolizing enzymes, and antioxidant property [57].



Niazimicin

MORINGA FOR IT'S ANALGESIC ACTIVITY

The analgesic activity of Moringa has been reported. In a study using ethanolic extracts of Moringa concanensis tender pod-like fruits in experimental animals, a significant analgesic activity was observed [58]. Alcoholic extract of the leaves and seeds of *Moringa oleifera* also possess analgesic activity as evidenced through hot plate and tail immersion test models [59].

ANTI-ASTHMATIC PROPERTY OF MORINGA

It has been reported a long time ago that Moringa plant can be used for the treatment of asthma [60]. The seed kernels of *Moringa oleifera* also showed prominent effect in the treatment of bronchial asthma. Also a study showed significant decrease in the severity of asthma symptoms and also concurrent respiratory functions improvement in various human models [61].

ANTI-OXIDANT PROPERTY OF MORINGA

Moringa oleifera is a rich source of antioxidant [62]. It has been given that aqueous extracts of leaf, fruit and seed of *Moringa oleifera* act as an antioxidant [63]. *Moringa oleifera* have the highest antioxidant activity with 65.1% (methanolic extract) and 66.8% (ethanolic extract) respectively [64]. It was also given that the

major bioactive compounds of phenolics, such as quercetin and kaempferol are responsible for antioxidant activity [65]. During another study, quercetin and kaempferol have shown good antioxidant activity on hepatocyte growth factor (HGF) [66]. Another recent study comparing palm oil with *Moringa Oleifera* seeds for their antioxidant potential found out that *Moringa oleifera* seed are superiors for radical scavenging, so they act as a better anti-oxidant [67].

CONCLUSION

This current article provided glimpses of *Moringa oleifera* applications in various pharmacological aspects and also its importance in nutrition which makes it a great medicinal plant. many bioactive compounds have been discovered from *Moringa* which makes it great miracle tree which can be used in the betterment of human society. More studies directed towards the detection, and commercialization of *Moringa oleifera* bioactive compounds can lead to the development of remedies for several diseases. Thus, it can also prove the traditional utilisation of *Moringa oleifera* in various folklores. The research on *Moringa oleifera* is yet to gain importance in India. It is essential that the nutrients of this wonder tree are exploited and exposed for a variety of purposes. *Moringa oleifera* has great anti-diabetic, Anti-tumor, ocular, anti-pyretic, anti-fungal, anti-cancer properties which can be great alternative of source for human welfare and betterment of society. It being a plant of great advantage must be included in the diet of people as it is great source of nutrition as well other dietary requirements.

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