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Moringa Oleifera, A Potential Miracle Tree; A Review

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Abstract: *Moringa oleifera Lam. Tree grows in many tropical and subtropical countries. It is grown for commercial purposes in places like South and Central America, Africa, India, Hawaii, Mexico and Asia.* The seed, leaves, root and flowers of *M. oleifera are often used in traditional medicine, while the immature pods, leaves and seed are used as nutrition products in human food. The extracts (Leaf) of M. oleifera plays a key role of safety studies in animals and antioxidant activity. So far, there were no adverse effects reported in humans. Some studies using powdered leaf preparations of M. oleifera have demonstrated anti-dyslipidemic and antidiabetic activities. These activities were verified using leaf powders and extracts in animals. Different studies have shown that hydroalcohol and aqueous extracts of M. oleifera leaf has a wide range of biological activities such as antihypertensive, tissue protective (kidneys, testes, lungs and heart), antiulcer, antioxidant, immunomodulatory and analgesic actions. Phenolic acids, polyphenols, alkaloids and flavonoids are responsible for the observed effects. The aim of this research work was to review M. oleifera as a potential miracle tree and to give more emphasis on it uses. Therefore, there is need to study the standardized extracts of M. oleifera* leaves *that can be used in wide range of areas. This research work would serve as a background for researches in the future.*

Keywords: *Extract, miracle, medicinal, Moringa oleifera, whole leaf powder*

I. Introduction

Moringa oleifera Lam. tree grows in many tropical and subtropical countries. It is grown for commercial purposes in places like South and Central America, Africa, India, Hawaii, Mexico and Asia. It was named ”horseradish” tree’ on the basis of ground root taste preparations, It was also named “drumstick tree” on the basis of its immature seed pods appearance and the “ben oil” tree on the basis of seed-derived oils. In some places, the immature seed pods are eaten, while the fresh leaves are commonly used as a basic food due to their high nutritional composition [1; 2; 3].

M. oleifera tree belongs to the family of Moringaceae, it is commonly called “drumstick tree” or horse radish tree, and locally called “zogale” in Hausa, Nigeria. It was well known for its multipurpose attributes, wide adoptability, and ease of establishment. According to [4] its leaves, pods, and flowers are packed with nutrients important to both human and animals. *M. oleifera* is a native to north India but is now found throughout the tropics. It is also known as horse radish tree, drumstick tree, and mothers best friend, It grows fast and reaches up to 12 m tall. The bark is grey and looks like cork peeling in patches. *M. oleifera* is adopted to a wide range of loamy to clay loam, it does not withstand prolonged water logging, it is preserved to prefer a neutral to slightly acidic soil been introduced with success to pacific tolls where soil pH is commonly greater than 8.5, it does best where temperature ranges from 25 °c to 40 °c and optimum annual rainfall total of 500mm.lt grows well from sea level to 10 m in elevation as stated by [4]. *M. oleifera* has its origin in the Arabia and India. Today, the tree is common to landscape all over the tropical area of the world, from south Asia to West Africa. It is most visible in parts of east South Africa. It now al so finds its way in to gardens on many pacific Islands from Kiribati to the northern Marianas as dicussed by [5].

M. oleifera is not a nitrogen fixing tree, but its fruits, flowers and leaves all contain 5% to 10% protein on average. All of these parts are eaten widely as vegetables; provide excellent food, for both humans and eaten like green beans. These roots taste similar to horse radish and is popular food (leaves) in the East Africa. *Moringa* flowers al so produce a good honey. The wood is light, but provides a fairly good fuel for cooking. It has density of 0.5-0.7 and yield approximately 4,600kcaL/kg as stated by [5].

The seeds are usually used as anticoagulant. Harvested dry seed are shelled crushed in to powdered form and made in to paste with the water before mixing with more water. [6] stated that, the mixed water is then allowed to settle and sieved its turbidity is extensively reduced including hardness reduction. The aim of this research work was to review *M. oleifera* as a potential miracle tree and to give more emphasis on it uses. Therefore, there is need to study the use of *M. oleifera* leaves and other organs that can be used in wide range of

areas. This research work would serve as a background for researches in the future. Previous literatures have shown that, there have been little researches on this topic despite the richness of *M. oleifera* plant.

II. Botany of Drumstick Tree

M. oleifera is fast growing perennials tree, which can reach a maximum height of 7-12m and a diameter of 20-60cm at chest height. The stem is normally straight, the tree grow with short, straight stem that reaches a height of 1.5-2.0m before it begins branching and it can reach up to 3.0m. The extended branches growing in a dis-organized manner as stated by [7] and the canopy is umbrella shape. The leaves are alternate, twice or thrice pinnate leaves grow mostly at the branch tips, they are 20-70m grayish downy when young, long petiole with 8-10 pair of pinnate each bearing two pairs of opposite, elliptic or obviate leaflet and at the apex, all 1-2cm with glands at bases of the petiole and pinnate.

The flowers, which are pleasantly fragrant, and 2.5cm wide are produced profusely in maxillary, drooping panides 10-25cm long. They are white or cream coloured and yellow doted at the base. The five reflexes sepals are linear lanceolate. The five (5) petals are slender spatulate, the surround the five (5) stamen and five (5) nodes and are a reflexed except for the lowest as mentioned by [7]. The fruits are three lobed pods which hang down from the branches and are 20-60cm in length when they are dry open into 3 parts, each pods contains between 12-35 seeds. The seeds are round with a brownish semi permeable seed hull. The hull itself has three (3) wings that run from top to the bottom at ‘120 degree intervals. Each tree can produce between 15,000 and 25,000 seeds per year. According to [8], the average weight per seed is 150.3g and the kernel to hull ratio is 7.2cm.

III. Drumstick Tree as a Potential Miracle Tree

All parts of *M. oleifera* can be used in a variety of ways. *Moringa* leaves is full of nutrients and vitamins *M. oleifera* leaves were reported to have 25.1% crude protein, 0.50% methionine and a metabolisable energy value of 227lkcal/kg as mentioned by [8]. A survey of over 120 species of tropical and subtropical edible plants for nutrient content, antioxidant activity, and a crop trait indicated that *M. oleifera* is one of the promising crops which could contribute to increased intake of micronutrient and antioxidant as discussed by [7]. *M. oleifera* leaves can be excellent sources of calcium, potassium and protein. It was also reported that the leaves of *M. oleifera* plant is an excellent source of vitamins, mineral and protein perhaps more than any other tropical vegetable. *Moringa* leaves extract have been reported to exhibit antimicrobial activities including inhibition for the growth of *Staphylococcus areus* that are commonly isolated from food and animals intestines, It also has a medicinal uses among the natives (Morton, 1999). In view of the above importance of *M. oleifera*, and some that are yet to be discovered, it’s important to have a comprehensive study of the Plant as whole as stated by [7].

IV. General Uses of Drumstick Tree

According to [9] *Moringa oleifera* is a perennial tree, having well developed roots, stem and leaves; it can be used in many ways. Researches on *M. oleifera* tree have accumulated different information on the uses of the plant in human consumption, medicinal uses, animal fodder, water purification, fertilizer, living fence, alley cropping, natural pesticide, fuel wood, and growth hormone for plant.

4.1 Human consumption

Moringa oleifera tree has probably been one of the most underutilized tropical crops. Leaves of *M. oleifera* could serve as a valuable source of nutrient for all age groups. In some parts of the world for example Senegal and Haiti, health workers have been treated malnutrition in small children, pregnant and nursing women with *M. oleifera* leaves powder. The leaves are known as a great source of vitamins and minerals being served raw, when cooked or dries as discussed by [10].

Fuglie reported that 8g serving of dried leaves powder will satisfy a child within age of 13 years with 14% of the protein, 40% of the calcium, 23% of the iron, and nearly all the vitamin A that the child needs in a day. 100g of leaves could provide women with over a third of her daily need of calcium and give her important quantities of iron, protein, copper, sulphur and vitamin B. Flowers can be cooked and mixed with other food or fried in butter. They can al so be place in hot water for five minutes to make a kind of tea for drinking. They are also a good source of nectar for honey producing bees. The pod can be eaten from the time they first appear to when they become too woody to snap easily (up to 30cm long). They are cooked like other green beans and have a similar flavour to asparagus. The root is medicinal and similar to horseradish source can be made from the roots when the seedling is only 60cm tall. According to [5], the root bark should be completely removed as it contains harmful substances, the root is grinded up and vinegar salt is added. The leaves of *M. oleifera* were rich and are of high nutritional values as presented in “**Table 1**”.

Table 1: Nutritious composition of Moringa oleifera leaf per 1 cup

Nutrients	Quantity
Vitamin B6	19% of the RDA.
Vitamin C	12% of the RDA.
Iron	11% of the RDA.
Riboflavin (B2)	11% of the RDA.
Vitamin A (from beta-carotene)	9% of the RDA.
Magnesium	8% of the RDA.
Protein	2 grams.

(Source: [11]).

4.2 Economic uses

Moringa oleifera seeds contain between 30-42% oil and the press-cake obtained as a by-product of the oil extraction process contains a very high level of proteins, some of these proteins (approximately 1%) are active cationic polyelectrolyte's, having molecular weight between 7-17 Daltons. The cationic polyelectrolyte neutralizes the colloids in moody or dirty water since the majority of these colloids have a negative electric charge. This protein can therefore be used as a non-toxic natural polypeptide for sedimentary mineral particles and organics in the purification of drinking water, for cleaning vegetable, oil, or for sedimentary fibers in the juice and beer industries as discussed by [9].

The properties of the natural polypeptide produced from the seeds of *Moringa* have been known for many centuries in china with the colonization of India by British, this knowledge was effective dispersed to the rest of the world. It has been employed with particular effectiveness in both Egypt and Sudan for cleaning water from Nile specifically for human consumption. Investigations have been conducted using seeds from *Moringa* for the final treatment in waste water treatment units. In oxidation lagoons, 80% of the oxygen demand of water is caused by unicellular algae. These algae al so contain between 40-60% of the nitrogen and phosphorus found in the pre treated waste water. To avoid eutrophication of rivers or lakes by the release of high loads of both phosphorus and nitrogen, the seed can be used to coagulate algae and removed by this treatment as mentioned by [9]. The seeds are usually used as anticoagulant. Harvested dry seeds are shelled and crushed in to powdered form and made it in to paste with the water before mixing with more water. According to [6], and [12]: the mixed water is then allowed to settled and sieved or use as turbidity is extensively reduced including hardness reduction.

4.3 Agricultural uses

Fertilizer the seed cake, which is produced by processing the seeds to extract oil, cannot be eaten as it contains harmful substances. However, it contains high levels of proteins and makes a good fertilizer for use in agriculture as stated by [5]. Using *Moringa* shoot as a green manure can significantly enrich agricultural and in this process, the land is first tilled. *Moringa* seed is then planted 2cm deep at a spacing of l0 x l0 cm (a density of 1 million seeds per hectare). The density can be greater, the only limit to plant density is the availability of seed, water and fertilizer, after 25 days. As mentioned by [13]: the seedlings are ploughed in to the soil to a depth of 15 cm and then prepared for the desired crop.

Moringa has a large tap root and few lateral roots so it will not compete for nutrients with the crops, it will also add to the nutrients available as it produces many protein rich leaves. They grow very quickly but do not provide too much shade due to the structure of their leaves. They are also very good as reclaiming, marginal land as stated by [5].

Fuel wood and other uses, the wood is light, but provides a fairly good fuel for cooking, it has density of 0.5 to 0.7 and yield approximately 4,600kcal/kg. However, [5] mentioned that, it is not suitable for building; the bark fiber is use in making rope, mats and the wood produce a blue dye, chipping of wood can be used to make a good quality paper, the trees also produce viscose resin that are used in the textile industries.

4.5 Plant Growth Hormones

Plant hormones (also known as phytohormones) are chemicals that regulate plants growth. Plants hormones are signal molecules produced within the plant and occur in extremely low concentrations. Hormones al so determines the formation of flowering, stem, leaves, the shedding of leaves and the development and ripening of fruits etc. as discussed by [7]. Hormone is derived from Greek and means set in motion' plant hormone affects gene expression and transcription levels, cellular division and growth. They are naturally produced within plants, similar chemicals are produced by fungi and bacteria that can al so affect plant growth. A large number of related chemical compounds are synthesized by humans; they are used to regulate the growth of cultivated plants. These manmade compounds are called plants growth hormone regulators or PGRs for short.

Hormones are transported within the plant by utilizing four (4) types of movements for localized movements. Cytoplasmic streaming within cells and slow diffusion of ions and molecules between the cells are utilized. Vascular tissues are used to move hormones from one part of the plant to another as discussed by [7].

4.5.1 Application

Growth hormones are well known to promote uniform growth through the cell enlargement. They cause plant to grow, affect flowering, stimulate seed germination, leaf formation etc. The extract obtained from the leaves of *Moringa* in 80% ethanol contains growth enhancing principle called zeatin (i.e hormone of the cytokinin type). According to [14]: The extract can be used in the form of a form of a foliar spray to accelerate the growth of young plant, used of the growth hormone spray will also cause the plant to be firmer and more resistance to pest and disease. Spraying the leaves of the plant with the *Moringa* extract diluted with distilled water produced some notable effect such as longer, more vigorous life span, heavier roots, stems and leaves, bigger fruits etc. as stated by [8].

4.5.2 Sources of growth hormones

Although several types of growth hormones are naturally produced within plant, similar chemicals are produced by fungi and bacteria that can also affect plant growth. Juice from 'fresh *Moringa* leaves can be used to produce effective growth hormones, increasing yield by 25-30% for nearly any group of plants (maize, bell pepper, tomato, soya, onion, sorghum, tea, coffee. melon and chili). One of the active substances is zeatin: a plant hormone from cytokinin group. This foliar spray should be used in addition to other fertilizer, watering and found agricultural practice [15]. In one fruit, the use of this hormone (spray) increase maize yield from 60-13 sacks per hectare. Using this hormone (spray) biomass was able to grow coffee at 30 meters altitude. Coffee, shade with Jatropha curcas, produced beans in just 17 months as discussed by Price [9]. The leaves of *Moringa* can be pressed to obtain a juice that, when mixed with 32 parts water and sprayed on fruits and vegetables, act as growth hormones. According to [15;16], yield increases between 25-30% due to plant hormones in agriculture, horticulture and biotechnology. Synthetic auxins are used as weed killers. Auxins are al so used to counteract the effect of hormone that promotes the dropping of fruits from trees (abscision). Gibberellins are used extensively to increase the size of seedless grapes, when applied at the appropriate time and with the proper concentration, gibberellins cause fruits to elongate, so that they are less tightly packed and less susceptible to fungal infections. They have also been sprayed on fruits and leaves of novel orange tree to prevent several rain disorder that appear during storage, they are used commercially to increase sugarcane growth as sugar yield. Cytokinin and auxin are used in plant cell culture, particularly in cultivating genetically engineered plants. The ability of cytokinin to retarded senescence also applies to certain cut flowers and fresh vegetables.

4.6 Medicinal Uses

Moringa oleifera is a small tree that is native to North India. It passes by an assortment of names, for example, drumstick tree, horse radish tree, or ben oil tree. All parts of the *M. oleifera* tree can be eaten or utilized as ingredients as a part of customary home grown drugs. The leaves and pods are commonly eaten in parts of India and Africa as stated by [11].

Around the world every part of the *Moringa* tree has been used effectively against varying ailments. The leaves rubbed against the temple can relieve headaches. To stop breeding from a shallow cut, apply a poultice of fresh leaves, there is an antibacterial and anti-inflammatory effect when applied to wound or insect bite. Extracts can be used against bacterial or fungal skin complaints. [5] stated that, eating *Moringa* as food product is a good for those suffering from malnutrition due to the high protein and fiber content.

The bark is boiled with potash to treat toothache and the seeds are grinded and taken orally for (H.I.V). The seeds are used for their antibiotic and anti-inflammatory properties to treat arthritis. According to [11] rheumatism, gout, cramp, sexually transmitted diseases and boils. The seed are roasted, pounded, mixed with coconut oil and applied to the problem area. Seed oil can be used for the same ailments [11].

4.6.1 Human Studies

A single dose research work with six type 2 diabetic cases, feeding of 50- 60 g of a *M. oleifera* leaf powder with a standard meal on a one-time basis reduced glucose levels of blood by 21% [17]. The decreased glucose response of blood to *M. oleifera* was not because of changes in the secretion of insulin.

[18] Studied the anti-dyslipidemic effects of *M. oleifera* in 35 type 2 diabetic cases. The experimental group has received 4.6 g of a *M. oleifera* leaf powder in a tablet form on daily basis for 50 days. It was compared with another group (control), the experimental cases experienced around 1.6% reduction in total plasma cholesterol and a 6.3% reduction in HDL. By comparing this work with the previous works, it can be suggested that the higher doses could be more effective.

In a summary form, the previous human researches have indicated that leaf powders of drumstick tree when given orally poses a significant antioxidant, anti-dyslipidemic, and anti-hyperglycemic effects in human cases without producing an adverse effects.

4.6.2 Animal and *In Vitro* Studies

A number of animal researches have been carried out involving the use of *M. oleifera* aqueous and aqueous alcohol extracts and leaf powder. These researches have exhibited the properties like anti-dyslipidemic, anti-hyperglycemic, antioxidant, immunomodulatory, tissue chemoprotectant, radioprotective, and anti-hyperglycemic antihypertensive effects.

Ethanol extract of drumstick tree leaf was effective in protecting against chromium-induced testicular toxicity in animals like rats [19]. After the extract was administered orally daily (500 mg/kg) for two months to rats that received 8-mg of potassium chromate on daily basis, this extract significantly ameliorated the testicular chromium effects on local immunity, inflammatory markers, antioxidant enzyme activities and sperm parameters.

The ability of *M. oleifera* leaves extract to prevent selenite-induced cataractogenesis was studied in rat pups weight of 10–15 g [20]. Pups have received sodium selenite (4 μg/g) subcutaneously on the 10^{th} day to induce cataracts. Additionally, some groups of animals have received (2.5 μg/g) of the extract from 8 to 15 days. The cataracts were visualized on the 16^{th} day. The extract has effectively prevented oxidative damage to the lens and morphological changes (cataracts).

Retinoprotective effects of drumstick tree in streptozotocin-induced diabetic rats were studied by [21]. Treatment with drumstick tree was found to prevent diabetes-induced dilation of retinal vessels and the increase in inflammatory factors tumor necrosis factor-α and interleukin-1β. Moreover, drumstick tree reduced the protein kinase C-β and diabetes-induced angiogenic factors vascular endothelial growth factor. The results showed that *M. oleifera* leaf extract could be useful in reducing diabetes-induced retinal dysfunction.

[22] Conducted a work by isolating niazirin, Niacimicin, rhamnosyloxy benzyl carbamate, derivatives of β-sitosterol and rhamnosyloxy benzyl isothiocyanate from *M. oleifera* seeds. Niacimicin wa found to show chemoprotective activity, by playing a kry role as a potent antitumor-promoting agent *in vivo* in a two-stage carcinogenesis assay in the skin of mouse. Niazarin and niaziridin obtained from leaves and pods of *M. oleifera* by [23]. It was noted that niazarin in the leaves was in higher concentrations, while niaziridin presence was approximately three times more than the amounts in leaves as compared with pods. The researchers found that niaziridin improved the bioactivity of different antibiotics and also speed the gastrointestinal absorption of nutrients and vitamins.

[24] Examined the phenolics and glucosinolates in *M. oleifera* seeds, roots and leaves. Rhamnosyloxy benzyl glucosinolates, acetylated isomers kaempferol 3-*O*-glucosides, caffeoylquinic acids and quercetin 3-*O*-glucosides were found in leaves. No anthocyanidins or proanthocyanidins were found to be present. This finding supports the earlier study of [25].

In a summary form, *M. oleifera has a* potentially bioactive compounds that are present in it. It extracts are mainly not standardized. Therefore, these extracts have been assessed based on their relative flavonoid, glucosinolate and polyphenol contents, with aqueous leaf extracts posessing the significant activities of these indicators [1; 26; 27]

V. Conclusion

Moringa oleifera leaves or other plant organs exhibit a wide kind of pharmacological and physiological activities. Researches in human have used powdered leaf preparations, while those of animal's studies were based on using hydroalcohol, alcohol (methanol or ethanol) and aqueous extracts of *M. oleifera* leaves and other plant organs to determine the antidiabetic (anti-hyperglycemic), antioxidant, chemoprotective and anti-dyslipidemic effects of *M. oleifera*. It is a tree with diverse potentialities that can be consume as food or process in another form to be used in different areas. There is need to study the standardized extracts of *M. oleifera* leaves that can be used in wide range of areas. This research work would serve as the background for future studies.

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