

Moringaoleifera: Nature is Most Nutritious and Multi-Purpose Tree

Fatima Al Gunaid Hassan*, Muna Abdalla Ibrahim**

*Assistance Professor, Field: Natural Resources, Environmental Science Faculty of Agriculture and Natural Resources, Forestry and Range Sciences Department, University of Bakht Er Ruda Ministry of Higher Education and Scientific Research Sudan White Nile state (AD Duwem)

** Food Science and Technology faculty of Agricultural and Natural Resources, Food Science and Technology Department University of Bakht Er Ruda Ministry Higher Education and Scientific Research Sudan White Nile state (AD Duwem).

Abstract- Moringaoleifera, commonly called the horseradish tree, drumstick tree, ben oil tree, miracle tree, and Mother's Best Friend, known for its multi-purpose attributes, wide adaptability, and ease of establishment. Its leaves, pods and flowers packed with nutrients important to both humans and animals. This review gives information regarding cultivation, nutrients and uses potentials of Moringaoleifera. Where diets lack in these essential nutrients the Moringa tree makes a major contribution to human health.

Index Terms- Moringaoleifera- multi-purpose- uses- cultivation- ecology

I. INTRODUCTION

In recent years, interest has grown in the utilization of what have come known as 'multipurpose' plants. One such plant is *Moringa oleifera* Lam (syn. *Moringa pterygosperma*), the most widely cultivated species of a monogeneric family Moringaceae. *Moringaoleifera* is one of the 14 species of family Moringaceae, native to India, Africa, Arabia, Southeast Asia, South America, and the Pacific and Caribbean Islands (Iqbal *et al.*, 2006). Because *M. oleifera* naturalized in many tropic and subtropics regions worldwide, a number of names such as horseradish tree, drumstick tree, ben oil tree, miracle tree, and Mother's Best Friend refer to the plant. (Jahn, 1981). It called 'Shagara al Rauwaq' in Nilevalley (von Maydell, 1986). According to Muluvi *et.al* (1999), the Moringa tree introduced to Africa from India at the turn of the twentieth century where used as a health supplement and it was originally an ornamental tree in the Sudan, planted during British rule in the alleys along the Nile, public parks, and the gardens of foreigners. It seems likely that the Arab women of Sudan discovered this remarkable clarifier tree (Jahn1986). The Moringa consumed by humans throughout the century in diverse culinary ways (Iqbal *et al.*, 2006). Almost all parts of the plant used for taste, flavor or as vegetable and seed activities (Chumark *et al*, 2008) culturally for its nutritional value, purported medicinal properties (DanMalam *et al*, 2001; Dahiru *et al*, 2006). The investigation of the different parts of the plant is multidisciplinary, including but not limited to nutrition, ethnobotany, medicine, analytical chemistry, phytochemistry and anthropology (McBurney *et al*, 2004). The purpose of this review is to summarize the uses and benefit of *Moringaoleifera*

II. IDENTIFICATION

Moringa is a small, fast-growing, drought deciduous tree or shrub that reaches 12 m in height at maturity. It has a wide-open, typically umbrella-shaped crown, straight trunk (10-30 cm thick) and a corky, whitish bark. The plant (depending on climate) has leaflets 1-2 cm in diameter and 1.5-2.5 cm in length its leaves are impari pinnate, rachis 3 to 6 cm long with 2 to 6 pairs of pinnules. Each pinnule has 3 to 5 obovate leaflets that are 1 to 2 cm long (Von Maydell, 1986). The terminal leaflet is often slightly larger. Its leaflets are quite pale when young, but become richer in color with maturity. Cream-colored flowers emerge in sweet-smelling panicles during periods of drought or water stress when the tree loses its leaves. The pods are triangular in cross-section-30 to 50 cm long and legume-like in appearance. The oily seeds are black and winged. The tree produces a tuberous taproot, which explains its tolerance to drought conditions (F/FRED, 1992).

III. ECOLOGY

Originally Moringa considered as a tree of hot semi-arid regions (annual rainfall 250-1500 mm), which is adaptable to a wide range of environmental conditions; from hot dry to hot, humid and wet conditions. The tree is tolerant to light frosts, but does not survive as a perennial under freezing condition. Moringa is quite drought tolerant and is well suited for a wide range of adverse environments that would not be suitable for other fruit, nut and tree crops. Moringa grows more rapidly, reaching higher heights, when found in well-drained soils with ample water, but tolerates sandy soils, heavier clay soils and water-limited conditions. The tree can be established in slightly alkaline soils up to pH 9 as well as acidic soils as low as pH 4.5 but it yields much less foliage (chumark *et al* 2008). In Oaxaca State, Mexico, traditional cultivation of *Moringaoleifera* carried out in the highlands even up to altitudes of 800-1200 m, if the sites protected by mountains. The highest site with abundantly flowering and fruiting *Moringa* trees was at San Juan Gegoyache in the valley of the Totolepan River. In Oaxaca, *Moringaoleifera* transferred from the lowlands of the Pacific coast toward this region because the tree provided poor people's white flowers for religious feasts in churches and houses. This successful migration also provides a good indication that *Moringa* trees can be grown in other micro-climates at similar altitudes even if up

until now it has been maintained that the tree is only suitable for lowlands under 600 m (Jahn 1986).

IV. OCCURRENCE THROUGHOUT THE WORLD

Moringa trees though native in the sub-Himalayan tracts, it is widely cultivated in Africa, Central and South America, Sri Lanka, India, Mexico, Malaysia, Indonesia and the Philippines (Anwar and Bhangar, 2003). According to Muluvi *et al* (1999), the Moringa tree wide natural spread in the world and introduced to Africa from India where it used as a health supplement and it was originally an ornamental tree in the Sudan, planted during British rule in the alleys along the Nile, public parks, and the gardens of foreigners. It seems likely that the Arab women of Sudan discovered this remarkable clarifier tree (Jahn, 1986). Table (1) illustrates the uses of different moringa species at different part of the world.

V. GROWING MORINGA

Moringa planted by direct seeding, transplanting, or using hard stem cuttings. Direct seeding is preferred when plenty of seed is available and labor is limited. Transplanting allows flexibility in field planting but requires extra labor and cost in raising seedlings. Stem cuttings are used when the availability of seed is limited but labor is plentiful (p.M.C. Palada and L.C. Chang 2003). Transplanting entails collection of seeds from the tree, development of plantlets in the greenhouse for two to three months and transplantation of mature stems (1-1.5 m long) to the main fields (chumark *et al*, 2008). *Moringa oleifera* is easily established by seed and no seed treatment is required (chumark *et al*, 2008). The rapidly germinating seedlings, can reach 5 m in one year if sheltered from drying winds and provided with enough water, however it normally cut back annually to one meter or less and allowed to regrow, so that pods and leaves remain within arm's reach (Shen *et al* 2006). Plants rose from 1 m cuttings bear pods from the second year of growth onwards, with maximum production at four to five years. An individual tree can yield 50 to 70 kg of pods in one year (Shen *et al* 2006). Moringa is an ideal tree for accompanying/ Inter-row crops and agro-forestry uses, as the branches can be easily trimmed to regulate shade effects; Its open crown allows plenty of sunlight to reach under-story crops often garden vegetables that benefit from some shading. Frequent pruning, lopping, coppicing or pollarding will increase and maintain leaf production. Moringa will sprout back repeatedly and vigorously when lopped or pollarded (chumark *et al* 2008) it is best to keep trees at a height that facilitates leaf harvesting. The leaves are attractive to all livestock however, so Limitation (Chen *et al* 2006) though quite tolerant to drought, the tree is deciduous, and it loses most of its leaves in periods of mended water-stress and susceptible to breakage in high winds. (p.M.C. Palada and L.C. Chang 2003) Moringa is relatively short-lived reaching only 20 years on average (vonMaydell, 1986) it is so easy to establish, however, this limitation does not discourage cultivation of this very useful and adaptable tree

VI. USES AND NUTRITIONAL BENEFIT

Every part of the Moringa tree used as medicine and food commodity, which has received enormous attention as the 'natural nutrition of the tropic'. According to Jed, *et al* (2005) and Anwar *et al* (.2005), Moringa trees have been used to combat malnutrition especially among infants and breastfeeding woman in many developing countries, particularly in India, Pakistan, the Philippines, Hawaii and many parts of Africa. Elkhalf, *et al* (2007) studies the nutritive values of the leaves of *M. Oleifera* tree (Rawag) which is available in Sudan and the results showed that, moisture content was 74.42%, protein 16.7% ,fiber 3.5%, ash 8%, and oil 1.7%. In addition, the minerals content were determined and they found that the calcium content was 0.20 mg/100g, magnesium 0.13mg/100g, potassium 0.075mg/100g, and phosphorus 0.031 mg/100g.

The pod, seed and oil

The pods are often cooked and eaten like green beans. The whole seeds also ate green, roasted or powdered, and steamed in tea and curries (Fahey, 2005). The pods and seeds, often referred to as Moringa kernels, have a taste that ranges from sweet to bitter and are most popularly consumed after frying to get a peanut-like taste (Makkar *et al*, 1996). The pods are generally prepared in a similar fashion to green beans and have a slight asparagus taste. The pods are highly nutritious containing all the essential amino acids (Ramachandran *et al.*, 1980). Although primarily utilized worldwide by the Asian Asia, Africa, America population as a vegetable, usage by other peoples is increasing. An international market already exists for both fresh and tinned pods (Jahn, 1986)

The leaves

Moringa leaf has been purported to be a good source of nutrition and a naturally organic health supplement that used in many therapeutic ways (McBurney *et al*, 2004; Fahey, 2005; DanMalam *et al*, 2001). The leaves are a very rich source of nutrients and contain the essential vitamins A, C and E. Table 2 illustrates the nutritional value of *M. Oleifera* leaves compare with other food (Fahey 2005).

Leaves rich in biologically active carotenoids, tocopherols and vitamin C have health-promoting potential in maintaining a balanced diet and preventing free-radical damage that can initiate many illnesses (Smolin *et al*, 2007) succulent leaves are harvested daily for soups, sauces, or salads. Can ate fresh, cooked, or stored as a dried powder for many months reportedly without any major loss of its nutritional value fresh leaves are picked, shade dried, ground to a powder, and then stored for later as a food flavoring or additive. Dried or fresh leaves used in foods such as soups and porridges (Lockett *et al*, 2000). Also used as curry gravy in noodles, rice or wheat (Abilgos *et al*, 1999). Farmers have added the leaves to animal feed to maintain a healthy livestock (Sarwatt *et al*, 2002; Fahey, 2005; Sáncheza *et al*, 2006). Newer applications include. In addition, the use of Moringa powder as a fish food in aqua cultural systems (Dongmeza *et al*, 2006) and the Moringa leaves as a protein supplement for animals, such as cows. The feeding value of Moringa reported to be similar to that of soybeans and rapeseed meal (Soliva *et al* 2005). Pregnant women and lactating mothers use the powdered leaves to enhance their child or children's

nourishment. especially, in underdeveloped countries mothers suffering from malnutrition (McBurney et al, 2004; Lockett et al, 2000; WHO Readers Forum, 1999). Kasolo et al (2011) stated that *Moringa oleifera* leaves were safe for human consumption because no serious side effects have been observed by the people using them. However, the toxicity of biologically active agents has been found to depend on the dose, they study the acute toxicity profile of *Moringa oleifera* leaves, they concluded that, *Moringa oleifera* leaves extracts of ether, ethanol and water contains phytochemical compounds which when given orally as a single dose in 24 hours to mice were relatively non-toxic.

The stem and bark

Planted as a hedge in courtyards, *Moringaoleifera* provides wind protection, shade and support for climbing garden plants. One can easily understand the household/garden component. The wood of *Moringa* is relatively soft. Because of this, is n' t used in heavy construction. The wood is light, but provides a good fuel for cooking. It yields approximately 4,600 kcal/kg (F/FR.F-D, 1992). The fiber from the bark used to make ropes. (Jahn, 1981)

The flowers

The *Moringa* flowers also produce a good honey and Honey clarifier in India and Sudan (Jahn, 1984)

The root

The root tastes similar to horse radish and is a popular food in East Africa (; Sattaur, 1983; Jahn, 1986).

Plant growth enhancer

Lab experimentation had shown that *Moringa* spray had a wide range of beneficial effects on plant crop. Effects of spray indicated accelerated growth of young plants. Plants were firmer, more resistant to pests and disease, longer life-span, heavier roots, stems and leaves, produced more fruit, larger fruit, increase in yield 20-35%f even a fraction of these results could be reproduced in the field, it could be a great help in increasing food supplies for millions of hungry people (Fahey 2005)

Medicinal Benefits

A number of natural compounds have been isolated from *M. oleifera* leaves including fully acetylated glycosides bearing thiocarbamates, carbamates or nitriles (Faizi et al., 1995; Murakami et al, 1998). Glycosides containing isothiocyanates, malonates and flavonoids also identified and isolated in the leaves of the *Moringa* plant.(Faiziet al, 1995; Bennett et al, 2003; Mian et al, 2001).Plant glycosides can be used as treatments for cancer or chronic conditions such as high cholesterol and atherosclerosis (Chumark et al, 2008; Ghasi et al, 2000). Plant flavonoids are important to the diet becauseof their effects on human nutrition. These phyto chemicals can modulate lipid peroxidation involved in atherogenesis, carcinogenesis and thrombosis and other known properties of free radical scavenging or inhibition of hydrolytic and oxidative enzymes (phospholipidase A2, cyclooxygenase, lipooxygenase), shows strong antioxidant and anti-inflammatory activity (Siddhuraju et al, 2003). Numerous studies have indicated that flavonoids also have anti-carcinogenic, anti-viral and anti-estrogenic activities

(Havstee, 2002; Mian et al., 2001and Middleton et al., 2000). These identified bioactive compounds in the leaves of *M. oleifera* make this an excellentcandidate for nutritional and pharmaceutical supplementation.The World Health Organization (WHO) has been studying the use of *M. oleifera* for many decades as a low cost supplement enhancer in the poorest countries around the world (WHO Readers Forum, 1999). This organization has been promoting the use of this plant to help those countries suffering from malnutrition, which is one of the major causes of death worldwide. United Nations Food and Agriculture reported that one in twelve people worldwide is malnourished, including 160 million children under the age of five (United Nations Food and Agriculture Statistics, 2008).

Water Purifier

In parts of the world where clean drinking water is scarce, *Moringa* offers another crucial benefit such as the ability to purify water. Many countries use river water as their primary water source, but this water can contain harmful particles, bacteria and microorganisms. Water treatment plants are not available in many countries, but if there, is a *Moringa* tree nearby, river water users can still enjoy clean water seed from (Jahn and Dirar, 1979; Jahn, 1981). The *Moringa* tree harvested from the seedpod, crushed, and then put into vats of the water. Harmful particles bind to the seed and sink after an hour of treatment, and then clean water can remove from the top of the vat (Jahn 1986).

VII. CONCLUSION

These findings together demonstrate that *moringa* is an excellent multiuse plant Used to improve the health and nutrition of communities and appears to be a most promising candidate from which specific nutraceutical bioactive products could be developed. In Sudan *moringa* has a great potential to cultivate as an economically profitable crop and contribute in poverty elevation.

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AUTHORS

First Author – Fatima Al Gunaid Hassan, Assistance Professor
Field: Natural Resources, Environmental Science Faculty of
Agriculture and Natural Resources, Forestry and Range Sciences
Department, University of Bakht Er Ruda Ministry of Higher
Education and Scientific Research Sudan White Nile state (AD
Duwem), Cell phone 00249911633434 (Email:
fatimagunaid@gmail.com)
Second Author – Muna Abdalla Ibrahim, Food Science and
Technology faculty of Agricultural and Natural Resources, Food
Science and Technology Department University of Bakht Er
Ruda Ministry Higher Education and Scientific Research Sudan
White Nile state (AD Duwem)., Cell phone 00249915117194
(Email: muaiibrahim@gmail.com)

Table (1): Uses and locations of the most important *Moringa* species

Use	<i>Moringaoleifera</i>	<i>Moringaperegrina</i>	<i>Moringastenopetala</i>	<i>Moringalongituba</i>	<i>Moringadrouhardii</i>	<i>Moringaovalifolia</i>
Vegetable	Asia, Africa, America (leaves green pods. flowers roasted seeds)		S. Ethiopia N. Kenya (leaves)			Namibia (roots)
Spice	Asia, Africa (mainly roots)		Kenya (bark)			
Oil (cooking, cosmetics, miscellaneous)	Asia, Madagascar, Africa, (seeds)	Near East			S. Madagascar	Lab. test, Angola
Water coagulant	Sudan (trad., seeds) Indonesia (new project)	Lab. test	Lab. & field tests	Lab. & field tests	Lab. & field tests	Lab. Test
Honey clarifier	Sudan (trad., seeds)					
Honey tree	Recent Indian studies					
Medicinal plant	Asia, Africa, Central America (all plant organs)	Near East as far as Sudan (seeds)	Kenya (bark, root, leaves)	Somalia (root)	S. Madagascar (bark, root)	Pounded seeds have also "horseradish smell"
Nematocide	Experiments in Philippines (roots)					
Fodder	India, Indonesia, (leaves)					Namibia (roots: game; leaves and fruits: giraffes)
Fences and windsheds	Asia, Africa, Central America		New suggestion in Sudan			
Supports for cultivation of climbers	Asia					
Firewood	Recent Indian project; Togo (trad.)					
Ornamental	Central & South America, USA, Africa	Saudi Arabia, Near East	Kenya		S. Madagascar	Namibia

Source: Jahn, 1986