

## ***Moringa oleifera*: a natural gift-A review**

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### **Abstract**

*Moringa oleifera*, Lam {Syn *M. pterygosperma* Gaertn} usually mentioned in literature as *Moringa*, is a natural as well as cultivated variety of the genus *Moringa* belonging to family *Moringaceae*. It is one of the richest plant sources of Vitamins A, B {1,2,3,6,7}, C,D,E and K. The vital minerals present in *Moringa* include Calcium, Copper, Iron, Potassium, Magnesium, Manganese and Zinc. It has more than 40 natural anti-oxidants. *Moringa* has been used since 150B.C. by ancient kings and queens in their diet for mental alertness and healthy skin. The leaves, pods, seeds, gums, bark and flowers of *Moringa* are used in more than 80 countries {including Pakistan} 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 anemic 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 and osteoporosis. It is also used to make an efficient fuel, fertilizer and livestock feed. *Moringa* is an edible extremely safe plant. Its tree could easily and cheaply be cultivated and grown in Pakistan. We need to explore therapeutic, nutritional and benefit of this gift of nature reported to be one of the world's most useful trees.

**Key Words** *Moringa*, benefits, nutritional value, therapeutic use

### **INTRODUCTION**

The plants have always been vital for mankind irrespective of the era and area all over the globe since the beginning of life. These were, are and will remain ever beneficial from nutritional, social, cultural, religious, environmental and human's health etc. The medicinal plants have greatest potential for benefitting people, especially those living in countries {like Pakistan} suffering from poverty, poor health, malnutrition, unemployment and isolation in international trade. The 21<sup>st</sup> century is the century of biology powered and propelled by scientific knowledge and technological expertise. Three technologies namely "Biotechnology", "Herbal technology" and "Information technology {Bioinformatics}" are going to be the most powerful elements that are crucial for prosperity and welfare for the people of nations. All technologies for the manufacture of value added plant products can be called as herbal technology. The global trade in herbals is increasing swiftly and in hundreds of billions in US\$. Pakistan is included among major players of import as well as export.

Some time we do not see gold which is present before our open eyes. There are many under

utilized plants in Pakistan which have the potential to bring lot of prosperity. "*Moringa*" an edible plant, is at the top of underutilized resources of Pakistan. "Its tree could easily and cheaply be cultivated and grown in Pakistan.

**Antiquity;** The indigenous knowledge and use of *Moringa* is referenced in more than 80 countries including Pakistan and known in over 200 local languages. *Moringa* has been used by various societies {Roman, Greek, Egyptian, and Indian to mention a few} for thousands of years with writings dating as far back as 150 AD. The history of *Moringa* dates back to 150 B.C. Historical proofs reveal that ancient kings and queens used *Moringa* leaves and fruit in their diet to maintain mental alertness and healthy skin. Ancient Maurian warriors of India were fed with *Moringa* Leaf Extract in the warfront. The Elixir drink was believed to add them extra energy and relieve them of the stress and pain incurred during war. These brave soldiers were the ones who defeated "Alexander" the Great. " {17, 32, 44 }

**Traditional Medicine ;** *Moringa* has been used in the traditional medicine passed down for centuries in many cultures around the world, for skin infections, anemia, anxiety, asthma, blackheads, blood impurities, bronchitis, catarrh, chest congestion, cholera,

conjunctivitis, cough, diarrhea, eye and ear infections, fever, glandular, swelling, headaches, abnormal blood pressure, hysteria, pain in joints, pimples, psoriasis, respiratory disorders, scurvy, semen deficiency, sore throat, sprain, tuberculosis, for intestinal worms, lactation, diabetes and pregnancy. The healing properties of Moringa oil, have been documented by ancient cultures. Moringa oil has tremendous cosmetic value and is used in body and hair care as a moisturizer and skin conditioner. *Moringa* oil has been used in skin preparations and ointments since Egyptian times. {17, 33, 38, 39, 44 }.

The present review is intended to create public awareness regarding benefit of an edible plant *Moringa* which is also known as miracle tree.

There are about 13 species of *moringa* trees in the genus *Moringa* of family *Moringaceae*. These are *Moringa oleifera*, *M. arborea*, *M. borziana*, *M. concanensis*, *M. drouhardii*, *M. hildebrandtii*, *M. longituba*, *M. ovalifolia*, *M. peregrine*, *M. pygmaea*, *M. rivae*, *M. ruspoliana*, and *M. stenopetala*. The most widely known species *Moringa oleifera* reported as "*Mpringa*" {34,44}.

*Moringa oleifera* is indigenous to south Asia, where it grows in the Himalayan foothills from northeastern Pakistan to northern West Bengal, India. It has been introduced and become naturalized in other parts of India, Pakistan, Afghanistan, Bangladesh, Sri Lanka, Southeast Asia, West Asia, the Arabian peninsula, east and west Africa, southern Florida, throughout the West Indies, and from Mexico to Peru, Paraguay, and Brazil. In Puerto Rico, it is grown chiefly as an ornamental and in fence rows and hedges and has become naturalized along roadsides on the coastal plains and lower foothills. In its native habitat, annual temperature fluctuations tend to be very large, with minimum and maximum shade temperatures ranging from -1 to 3°C and from 38 to 48°C during the coldest and warmest months, respectively. In this region annual rainfall ranges from 750 to 2200 mm. Reseda is highly drought tolerant and is cultivated in semiarid and arid regions of India, Pakistan, Afghanistan, Saudi Arabia and east Africa,

receiving an annual rainfall as low as 300 mm, although such sites are probably irrigated or are characterized by a high water table. In Puerto Rico, Reseda has become naturalized to a limited extent on sites with an annual rainfall between 1000 and 1800 mm. {14, 26, 33, 34, 36, 38}. *Moringa oleifera* is cultivated in Sindh province of Pakistan. {32}.

The taxon name *moringa* comes from murunggi or muringa from Tamil and Malayalam. *Moringa* is available and known by more than 50 common names in Asia, Africa, Europe, South and Central America, Caribbean. Some are Drumstick tree, Horse radish tree, Mother's best friend, West Indian ben are in English, Ben, Árbol del ben, Morango, *Moringa* in Spanish, Mupulanga in Zimbabwe, Aleko, Haleko in Ethiopia, and Bèn ailé, Benzolive, in French. Suhanjna is the common name in Pakistan {8, 32, 34, 44}.

*Moringa* is very impressive and amazing plant due to its tested, trusted and potential benefits from nutritional as well as therapeutic point of view. This friendly plant is of great significance as shown to be useful in water purification, cosmetics, livestock fodder, plant growth enhancer and biogas. In the last ten years, hundreds of research articles, theses, reports, and patents have been published on *Moringa*. Newspapers, scientific journals, documentaries {Discovery Channel} feature *Moringa* more and more. The Church World Service recently organized the first ever *Moringa* Tree International Conference to educate about *Moringa's* use as an indigenous resource for fighting hunger and malnutrition {15, 16, 17, 33,44}.

## USES / BENEFITS OF MORINGA

*Moringa oleifera* is the most nutrient-rich plant yet discovered. This humble plant has been making strides in less-developed societies for thousands of years, and significant nutritional research has been conducted since the 1970s. *Moringa* provides a rich and rare combination of nutrients, amino acids, antioxidants, antiaging and anti-inflammatory properties used for nutrition and healing. *Moringa* is sometimes called "Mother's Best Friend" and

"Miracle Tree." Since 1998, the World Health Organization has promoted Moringa as an alternative to imported food supplies to treat malnutrition {27, 32, 43, 44, 45}.

**Nutritional Uses/ Benefit;** A large number of reports on the nutritional qualities of Moringa now exist in both the scientific and the popular literature. *Moringa* has been in use since centuries for nutritional as well medicinal purposes. These include vitamin C, which fights a host of illnesses including colds and flu; vitamin A, which acts as a shield against eye disease, skin disease, heart ailments, diarrhea, and many other diseases; Calcium, which builds strong bones and teeth and helps prevent osteoporosis; Potassium, which is essential for the functioning of the brain and nerves, and Proteins, the basic building blocks of all our body cells. Another important point is that Moringa leaves contain all of the essential amino acids, which are the building blocks of proteins. It is very rare for a vegetable to contain all of these amino acids. And *Moringa* contains these amino acids in a good proportion, so that they are very useful to our bodies. These leaves could be a great boon to people who do not get protein from meat. *Moringa* even contains argenine and histidine two amino acids especially important for infants. Argenine and histidine, are especially important for infants who are unable to make enough protein for their growth requirements. Experts tell us that 30% of children in sub-Saharan Africa are protein deficient. *Moringa* could be an extremely valuable food source {2, 8, 15, 16, 17, 30, 32, 35}.

Given its nutritional value, it can be utilized in fortifying sauces, juices, spices, milk, bread, and most importantly, instant noodles. Many commercial products like Zija soft drink, tea, and neuroceuticals are available all over the globe. A comparative study of *Moringa* fresh leaves gram for gram with other foodstuffs puts *Moringa* on top.{Table.1} It contains {seven times the vitamin C of oranges}; {four times the vitamin A of carrots}, {four times the calcium of milk}, {three times the potassium of banana} and {two times the protein of

yogurt}.But the micro-nutrient content is even more in dried leaves; {ten times the vitamin A of carrots}, {17 times the calcium of milk}, {15 times the potassium of bananas}, {25 times the iron of spinach} and {nine times the protein of yogurt}. However, Vitamin C drops to half that of oranges{23,31,32,33,44}.

Table.1 Nutritional value of *Moringa* compared with other food

<i>Content of</i>	<i>Moringa</i>	<i>other food</i>
Vitamin A	6,780 mg	caroot: 1,890 mg
Vitamin C	220 mg	Orange: 30 mg
Calcium	440 mg	cow milk: 120 mg
Potassium	259 mg	Banana: 88 mg
Protein	6. 6 g	Cow milk: 3,2 g

*Moringa* is an alternative to imported food supplies to treat malnutrition in poor countries. *Moringa* trees have been used to combat malnutrition, especially among infants and nursing mothers. Three non-governmental organizations in particular—Trees for Life, Church World Service and Educational Concerns for Hunger Organization—have advocated *Moringa* as “natural nutrition for the tropics.” Leaves can be eaten fresh, cooked, or stored as dried powder for many months without refrigeration, and reportedly without loss of nutritional value. *Moringa* is especially promising as a food source in the tropics because the tree is in full leaf at the end of the dry season when other foods are typically scarce. Leaves were also used for food fortification{15, 16, 17, 30, 31, 44}.

In 1997-98, Alternative Action for African Development {AGADA} and Church World Service tested the ability of *Moringa* leaf powder to prevent or cure malnutrition in pregnant or breast-feeding women and their children in southwestern Senegal. Malnutrition was a major problem in this area, with more than 600 malnourished infants treated every year. During the test, doctors, nurses, and midwives were trained in preparing and using *Moringa* leaf powder for treating malnutrition. Village women were also trained in the

preparation and use of *Moringa* leaf powder in foods. Result had indicated that children maintained or increased their weight and improved overall health, pregnant women recovered from anemia and had babies with higher birth weights and breast-feeding women increased their production of milk. {17,41}

**Therapeutic uses/ benefit** “Phytochemicals refers to only those chemicals which may have an impact on health, or on flavor, texture, smell, or color of the plants, but are not required by humans as essential nutrients. *Moringa* contains a range of fairly unique phytochemicals. containing the simple sugar, rhamnase, and it is rich in a fairly unique group of compounds called glucosinolates and isothiocyanates. Six such phytochemicals have been reported to have hypotensive, anticancer, and antibacterial activity include benzyl isothiocyanate , niazimicin , pterygospermin, benzyl isothiocyanate , and 4- $\alpha$ -L-rhamnopyranosyloxy}benzyl glucosinolate {4,10 11, 15, 16, 17,}.

Numerous studies now point to the elevation of a variety of detoxication and antioxidant enzymes and biomarkers as a result of treatment with *Moringa* or with phytochemicals isolated from *Moringa* have shown, antiulcer, effect on immune response, spasmolytic activities, hypocholesterolemic effects , antibacterial activity. sympatholytic activity and antiviral activity against herpes simplex virus type-1. {18, 19, 21, 22, 24, 25}

Antioxidants play an important role in inhibiting and scavenging free radicals, thus providing protection to human against infections and degenerative diseases. The data obtained in suggests that the extracts of *Moringa oleifera* both mature and tender leaves have potent antioxidant activity against free radicals, prevent oxidative damage to major biomolecules and afford significant protection against oxidative damage. {43, 46}

**Animal feed fortification;** *Moringa* leaves added to cattle feed increased their daily weight gain by up to 32 percent. Feed of milk cows was supplemented with 15 to 17 kilograms of fresh *Moringa* leaves daily, and the cattle’s milk production increased by 43 percent. Feed

supplemented with 2 kg dry matter and milk production increased by 58 percent. Then feed supplemented with 3 kg dry matter per day, and milk production increased by 65 percent. Imagine what would be possible if milk production in developing countries could be increased in this way. It could prevent untold suffering of people with protein deficiency. {13, 14}

**Plant growth enhancer;** Lab experimentation had shown that *Moringa* spray had a wide range of beneficial effects on plant crops. 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% If 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. {13}

**Water purification:** A billion people across Asia, Africa, and Latin America are estimated to rely on untreated surface water sources for their daily water needs. Of these, some two million are thought to die from diseases caught from contaminated water every year, with the majority of these deaths occurring among children under five years of age.

Powdered seed act as a natural flocculent, able to clarify even the most turbid water Seed powder can be used as a quick and simple method for cleaning dirty water. The powder joins with the solids in the water and sinks to the bottom. This treatment also removes 90-99% of bacteria contained in water, water purification by flocculation, sedimentation, antibiosis and even reduction of Schistosome cercariae titer. Using *Moringa* to purify water replaces chemicals such as aluminum sulphate, which are dangerous to people and the environment, and are expensive. Twenty litres of water may be purified by adding 2 grams of powder to one cup of clean water, pour into a bottle and shake for 5 minutes. Filter the solution through a clean cloth into the bucket of dirty water that is to be treated. Stir the water quickly for 2 minutes and slowly for 10 to 15 minutes {do not use metal implements}.Leave

the bucket undisturbed for one hour or until the water becomes clear and the impurities have sunk to the bottom. Filter the water through a clean cloth Boil the water before drinking. {20,26,28,42,46}

**Moringa oil:** *Moringa Oleifera* is the best known of the 13 species of the genus *Moringaceae*. It was highly valued in the ancient world. The Romans, Greeks and Egyptians extracted edible oil from the seeds and used it for perfume and skin lotion. In the 19th century, plantations of *Moringa* in the West Indies exported the oil to Europe for perfumes and lubricants for machinery. A study was done in Pakistan to examine the physico-chemical characteristics of *Moringa oleifera* seeds and seed oil from a wild provenance of Pakistan. The *Moringa* seeds harvested from the forests of Kohat district of NWFP exhibited an oil yield of 34.80%. Protein, fiber, moisture and ash contents were 31.65, 7.54, 8.90 and 6.53%, respectively. The extracted *M.oleifera* seed oil revealed an iodine value of 68.63; refractive index {40°C}, 1.4571; density {24°C}, 0.9032 g cm<sup>-3</sup>; saponification value, 181.4; unsaponifiable matter, 0.74%; acidity {as oleic acid} 0.81% and color {1-in. cell} 1.28 R + 31.00 Y. Determinations of oxidation parameters like induction period {Rancimat 20 L/h, 120°C}, specific extinctions at 232 and 270 nm, peroxide- and *p-anisidine* values demonstrated a good oxidative stability of the investigated *M. oleifera* oil. Tocopherols { $\alpha$ ,  $\gamma$  and  $\delta$ } contents of the oil amounted to 140.5, 63.18 and 61.70 mg kg<sup>-1</sup>, respectively and were reduced considerably after degumming. The major sterol components of the oil were  $\beta$ -sitosterol {46.16%}, campesterol {17.59%}, stigmasterol {18.80%} and  $\Delta^5$ , avenasterol {9.26%}. The wild *M. oleifera* seed oil was found to contain oleic acid up to 73.22%, followed by palmitic, stearic, behenic and arachidic acids 6.45, 5.50, 6.16 and 4.08%, respectively and fell in the category of high-oleic oils. The results of different quality attributes of *M. oleifera* oil from a wild provenance of Pakistan reveal that it could be employed for edible and commerce. {1,5,12,17,33,44}

## CONCLUSION;

The *Moringa Oleifera* plant is the most inexpensive and credible alternative to not only providing good nutrition, but also the cure and prevention of a lot of diseases. *Moringa* tree could easily and cheaply be cultivated and grown in Pakistan.

We need to design and develop strategy on war footing in order to explore and utilize full benefits of this miracle tree. The research project should be made for commercial production of food product, nutraceuticals, *Moringa* oil {edible as well as cosmetics}, fortified feed for cattle, biogas, and plant fertilizer. The plants for water purification by *moringa* should be designed.

The clinical studies with human subjects should be taken to investigate: nutrient bio-availability and bio-toxicity, positive effects on the immune system in fighting diseases, such as: malnutrition, HIV/AIDS, and sexually transmitted infections tuberculosis effects claimed by traditional medicine in regard to diseases, such as: hypertension, diabetes and high blood pressure, antioxidant properties in fighting diseases, such as: heart disease, cancer and Alzheimer's disease.

The poor countries should promote planting and use of *Moringa* instead of waiting for bounties of food relief from the rich west.

Pakistan could easily fight against the problems of malnutrition, hunger, poverty, diseases, unemployment, and edible oil export by utilizing its full benefits. The lot foreign exchange could be earned by exporting product of *Moringa* instead spending foreign exchange on imports.

*Moringa* truly appears to be a "Miracle" plant having countless benefits for humanity and thus should be taken as a high quality **gift of nature** at very low price. .

## REFERENCES

- [1] Anwar F, and MI Bhangar {2003} Analytical characterization of *Moringa oleifera* seed oil grown in temperate regions of Pakistan. Journal of Agricultural and Food Chemistry 51: 6558-6563.
- [2] Babu SC {2000} Rural nutrition interventions with indigenous plant foods: a case study of

- vitamin deficiency in Malawi. International Food Policy Research Institute, Washington, DC. Biotechnology, Agronomy Soc. Environ. 4{3}: 169-179.:
- [3] Caceres A, A Saravia, S Rizzo, L Zabala, E De Leon, F Nave {1992} Pharmacologic properties of *Moringa oleifera*. 2: Screening for antispasmodic, antiinflammatory and diuretic activity. Journal of Ethnopharmacology 36: 233-237.
- [4] Costa-Lotufo LV, MTH Khan, A Ather, DV Wilke, PC Jimenez, C Pessoa, MEA de Moraes MO de Moraes {2005} Studies of the anticancer potential of plants used in Bangladeshi folk medicine. Journal of Ethnopharmacology 99: 21-30.
- [5] Dahot MU, and AR Memon {1987} Properties of *Moringa oleifera* seed lipase. Pakistan Journal of Scientific and Industrial Research 30{11}: 832-835.
- [6] Dayrit FM, AD Alcantar, and IM Villasenor {1990} Studies on *Moringa oleifera* seeds, Part I: The antibiotic compound and its deactivation in aqueous solution. Philippine Journal of Science. 119: 23-32
- [7] Delisle H, S Bakari, et al. {1997} Provitamin A content of traditional green leaves from Niger. Cahiers Agricultures 6{6}: 553-560
- [8] Duke JA {1987} Moringaceae: Horseradish-tree, benzolive-tree, drumstick-tree, sohnja, moringa, murunga-kai, malunggay, p. 19-28. In: M. Bengé {ed.} *Moringa: A multipurpose vegetable and tree that purifies water*. Sci. & Technol./ For., Environ., & Natural Resources Agro-Forestation Tech. Ser. 27. US AID, Washington, D.C.
- [9] Ezeamuzie IC, AW Ambakederemo, et al. {1996} Antiinflammatory effects of *Moringa oleifera* root extract. International Journal of Pharmacognosy 34{3}: 207-212.
- [10] Fahey JW, AT Dinkova-Kostova, and P Talalay {2004} The "Prochaska" microtiter plate bioassay for inducers of NQO1. Chapter 14 in *Methods in Enzymology*, Vol. 382, Part B, pp. 243-258 {Eds.} H. Sies & L. Packer, Elsevier Science, San Diego, CA.
- [11] Faizi S, BS Siddiqui, R Saleem, K Aftab, F Shaheen, AH Gilani {1998} Hypotensive constituents from the pods of *Moringa oleifera*. *Planta Medica* 64: 225-228.
- [12] Farooq ,A\* and Rashid, U {2007}. Physico-chemical characteristics of *Moringa oleifera* seeds and seed oil from a wild provenance of Pakistan Pak. J. Bot., 39{5}: 1443-1453,
- [13] Foidl, N., Makkar, H.P.S. and Becker, K. {2001} The potential of *Moringa oleifera* for agricultural and industrial uses.
- [14] Francis, John K.; Liogier, Henri A. {1991}. Naturalized exotic tree species in Puerto Rico. Gen. Tech. Rep. SO-82. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station. 12 p
- [15] Fuglie LJ {1999} *The Miracle Tree: Moringa oleifera: Natural Nutrition for the Tropics*. Church World Service, Dakar. 68 pp.; revised in 2001 and published as *The Miracle Tree: The Multiple Attributes of Moringa*, 172 pp..
- [16] Fuglie LJ {2000} *New Uses of Moringa Studied in Nicaragua*. ECHO Development Notes #68, June, 2000.
- [17] Fuglie, Lowell J., ed. *The Miracle Tree: Moringa oleifera: Natural Nutrition for the Tropics*. Training Manual. 2001. Church World Service, Dakar, Senegal
- [18] Galan MV, AA Kishan, AL Silverman {2004} Oral broccoli sprouts for the treatment of *Helicobacter pylori* infection: A preliminary report. *Digestive Disease Science* 49{7-8}: 1088-1090.
- [19] Galan MV, AA Kishan, AL Silverman {2004} Oral broccoli sprouts for the treatment of *Helicobacter pylori* infection: A preliminary report. *Digestive Disease Science* 49{7-8}: 1088-1090
- [20] Gassenschmidt U, KD Jany, B Tauscher, and H Niebergall {1995} Isolation and characterization of a flocculating protein from *Moringa oleifera* Lam. *Biochimica Biophysica Acta* 1243: 477-481.
- [21] Ghasi S, E Nwobodo, and JO Ofili {2000} Hypocholesterolemic effects of crude extract of leaf of *Moringa oleifera* Lam in high-fat diet fed Wistar rats. *Journal of Ethnopharmacology* 69{1}: 21-25.
- [22] Gilani AH, K Aftab, A Suria, S Siddiqui, R Saleem, BS Siddiqui, S Faizi {1994} Pharmacological studies on hypotensive and spasmolytic activities of pure compounds from *Moringa oleifera*. *Phytotherapy Research* 8{2}: 87-91.
- [23] Gopalan, C., B.V. Rama Sastri, and S.C. Balasubramanian. {1971} revised and updated by B.S. Narasinga Rao, Y.G. Deosthale, and K.C. Pant, {1989} *Nutritive value of Indian foods*. National Institute of Nutrition, Hyderabad, India:
- [24] Hameed-Un-Nisa L, D Shehnaz, and S Faizi {1998} Measurement of sympatholytic activity of *Moringa oleifera*. *New Trends in Natural Products Chemistry [6<sup>th</sup> International Symposium on Natural Products Chemistry]* 269-277. Harwood Amsterdam.
- [25] Haristoy X, JW Fahey, I Scholtus, and A Lozniewski. {2005} Evaluation of antimicrobial effect of several isothiocyanates on *Helicobacter pylori*. *Planta Medica* 71: 326-330
- [26] Jahn SA, HA Musnad and H Burgstaller {1986} *Tree that purifies water: Cultivating multipurpose Moringaceae in the Sudan*. *Unasylyva* 38{152}: 23-28..

- [27] Johnson BC {2005} Clinical perspectives on the health effects of *Moringa oleifera*: A promising adjunct for balanced nutrition and better health. KOS Health Publications August 2005: 1-
- [28] Kumar S, and K Gopal {1999}. Screening of plant species for inhibition of bacterial population of raw water. *Journal of Environmental Science and Health Part A Toxic Hazardous Substances and Environmental Engineering*. 34{4}: 975-987.
- [29] Lipipun V, M Kurokawa, R Suttisri, P Taweechotipatr, P Pramyothin, M Hattori, K Shiraki {2003}. Efficacy of Thai medicinal plant extracts against herpes simplex virus type 1 infection in vitro and in vivo. *Antiviral Research* 60: 175-180
- [30] Lockett, C. T., C. C. Calvert, . {2000} Energy and micronutrient composition of dietary and medicinal wild plants consumed during drought. Study of rural Fulani, Northeastern Nigeria. *International Journal of Food Sciences and Nutrition*. 51{3}: 195-208.
- [31] . Mahatab, S.N; Ali, A.; Asaduzzaman, A.H.M. 1987. Nutritional potential of sajna leaves in goats. *Live stock Advisor*. 12 {12}: 9-12
- [32] Manzoor, M., F.Anwar, T.Iqbal and M.I.Bhnager. 2007. Physico-chemical characterization of *Moringa concanensis* seeds and seed oil. *J. Am. Oil Chem. Soc.*, 84: 413-419.
- [33] Monica G. Marcu, {2005}. *Miracle Tree*, KOS Health Publications
- [34] Nasir, E.; Ali, S.I., eds. {1972}. *Flora of West Pakistan: an annotated catalogue of the vascular plants of west Pakistan and Kashmir*. Karachi, Pakistan: Fakhri Printing Press. 1028p.
- [35] Oliveira JTA, SB Silveira, et al. {1999} Compositional and nutritional attributes of seeds from the multiple purpose tree *Moringa oleifera* Lamarck. *Journal of the Science of Food and Agriculture*. 79{6}: 815-820
- [36] Palada MC, and LC Chang {2003}. Suggested cultivation practices for *Moringa*. AVRDC Publication #03-545;
- [37] Palaniswamy U {2005}. *Purslane—Drumsticks Lok-Vani* {e-journal} <http://www.lokvani>
- [38] Ramachandran, C.;Peter K.V:Gopalakrishnan,P.K {1980} *Drumstick {Moringa oleifera}: a multipurpose Indian vegetables*, *Economic Botany*,34{3}:276-283
- [39] Sairam, T.V.{1999}. *Home remedies, Vol II: A Handbook of Herbal Cures for Commons Ailments*. New Delhi, India: Penguin
- [40] Saint Sauveur {2001}. “*Moringa exploitation in the world: State of knowledge and challenges.*” *Development Potential for Moringa Products*. International Workshop, Dar es Salaam, Tanzania, 29 Oct. - 2 Nov. 2001
- [41] Sambou D, B. { 2001}. “*Supplementation for pregnant and breast-feeding women with Moringa oleifera powder.*” *Development Potential for Moringa Products*. International Workshop, Dar es Salaam, Tanzania, 29 Oct. - 2 Nov. 2001
- [42] Sutherland, J.P., Folkard, G.K. & Grant, W.D.{1989} “*Seeds of Moringa species as naturally occurring flocculants*”, *Science, Technology & Development*, , Vol.7, No.3, pp.1 91-197.
- [43] Sreelatha & Padma {2009}. Antioxidant Activity and Total Phenolic Content of *Moringa oleifera* Leaves in Two Stages of Maturity. *Plant Foods for Human Nutrition* 64, 303-311
- [44] *Trees For Life* {2005}. *Moringa Book*. <http://www.treesforlife.org/project/moringa/book/default.asp>..
- [45] United Nations World Food Programme. *Interactive Hunger Map*. 2004. December 2004. <[www.wfp.org](http://www.wfp.org)
- [46] Yongbai KA {2005} *Studies on the potential use of medicinal plants and macrofungi {lower plants} in water and waste water purification*. [www.biotech.kth.se/iobb/news /kenneth04.doc](http://www.biotech.kth.se/iobb/news/kenneth04.doc)