

Reviews

***Moringa oleifera*: A Review of the Medical Evidence for Its Nutritional, Therapeutic, and Prophylactic Properties. Part 1.**

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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, mlonge, mulangay, nébéday, saijhan, and sajna. Over the past two decades, many reports have appeared in mainstream scientific journals describing its nutritional and medicinal properties. Its utility as a non-food product has also been extensively described, but will not be discussed herein, (e.g. lumber, charcoal, fencing, water clarification, lubricating oil). As with many reports of the nutritional or medicinal value of a natural product, there are an alarming number of purveyors of “healthful” food who are now promoting *M. oleifera* as a panacea. While much of this recent enthusiasm indeed appears to be justified, it is critical to separate rigorous scientific evidence from anecdote. Those who charge a premium for products containing *Moringa* spp. must be held to a high standard. Those who promote the cultivation and use of *Moringa* spp. in regions where hope is in short supply must be provided with the best available evidence, so as not to raise false hopes and to encourage the most fruitful use of scarce research capital. It is the purpose of this series of brief reviews to: (a) critically evaluate the published scientific evidence on *M. oleifera*, (b) highlight claims from the traditional and tribal medicinal lore and from non-peer reviewed sources that would benefit from further, rigorous scientific evaluation, and (c) suggest directions for future clinical research that could be carried out by local investigators in developing regions.

This is the first of four planned papers on the nutritional, therapeutic, and prophylactic properties of Moringa oleifera. In this introductory paper, the scientific evidence for health effects are summarized in tabular format, and the strength of evidence is discussed in very general terms. A second paper will address a select few uses of Moringa in greater detail than they can be dealt with in the context of this paper. A third paper will probe the phytochemical components of Moringa in more depth. A fourth paper will lay out a number of suggested research projects that can be initiated at a very small scale and with very limited resources, in geographic regions which are suitable for Moringa cultivation and utilization. In advance of this fourth paper in the series, the author solicits suggestions and will gladly acknowledge contributions that are incorporated into the final manuscript. It is the intent and hope of the journal's editors that such a network of small-scale, locally executed investigations might be successfully woven into a greater fabric which will have enhanced scientific power over similar small studies conducted and reported in isolation. Such an approach will have the added benefit that statistically sound planning, peer review, and multi-center coordination brings to a scientific investigation.

The following paper is intended to be useful for both scientific and lay audiences. Since various terms used herein are likely not familiar to the lay reader, nor are many of the references readily available to either scientific or lay audiences, we encourage active on-line dialog between readers and both the author and the journal staff. Both will attempt to answer questions and to direct readers to the experts in an open and public manner.

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PEER REVIEWED

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 rapidly-growing tree (also known as the horseradish tree, drumstick tree, benzolive tree, kelor, marango, mlonge, moonga, mulangay, nébéday, saijhan, sajna or Ben oil tree), was utilized by the ancient Romans, Greeks and Egyptians; it is now widely cultivated and has become naturalized in many locations in the tropics. It is a perennial softwood tree with timber of low quality, but which for centuries has been advocated for traditional medicinal and industrial uses. It is already an important crop in India, Ethiopia, the Philippines and the Sudan, and is being grown in West, East and South Africa, tropical Asia, Latin America, the Caribbean, Florida and the Pacific Islands. All parts of the Moringa tree are edible and have long been consumed by humans. According to Fuglie (47) the many uses for Moringa include: alley cropping (biomass production), animal forage (leaves and treated seed-cake), biogas (from leaves), domestic cleaning agent (crushed leaves), blue dye (wood), fencing (living trees), fertilizer (seed-cake), foliar nutrient (juice expressed from the leaves), green manure (from leaves), gum (from tree trunks), honey- and sugar cane juice-clarifier (powdered seeds), honey (flower nectar), medicine (all plant parts), ornamental plantings, biopesticide (soil incorporation of leaves to prevent seedling damping off), pulp (wood), rope (bark), tannin for tanning hides (bark and gum), water purification (powdered seeds). Moringa seed oil (yield 30-40% by weight), also known as Ben oil, is a sweet non-sticking, non-drying oil that resists rancidity. It has been used in salads, for fine machine lubrication, and in the manufacture of perfume and hair care products (158). In the West, one of the best known uses for Moringa is the use of powdered seeds to flocculate contaminants and purify drinking water (11,50,113), but the seeds are also eaten green, roasted, powdered and steeped for tea or used in curries (50). This tree has in recent times been advocated as an outstanding indigenous source of highly digestible protein, Ca, Fe, Vitamin C, and carotenoids suitable for utilization in many of the so-called “developing” regions of the world where undernourishment is a major concern.

Nutrition

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.

A large number of reports on the nutritional qualities of Moringa now exist in both the scientific and the popular literature. Any readers who are familiar with Moringa will recognize the oft-reproduced characterization made many years ago by the Trees for Life organization, that “ounce-for-ounce, Moringa leaves contain more Vitamin A than carrots, more calcium than milk, more iron than spinach, more Vitamin C than oranges, and more potassium than bananas,” and that the protein quality of Moringa leaves rivals that of milk and eggs. These readers will also recognize the oral histories recorded by Lowell Fuglie in Senegal and throughout West Africa, who reports (and has extensively documented on video) countless instances of lifesaving nutritional rescue that are attributed to Moringa (47,48). In fact, the nutritional properties of Moringa are now so well known that there seems to be little doubt of the substantial health benefit to be realized by consumption of Moringa leaf powder in situations where starvation is imminent. Nonetheless, the outcomes of well controlled and well documented clinical studies are still clearly of great value.

In many cultures throughout the tropics, differentiation between food and medicinal uses of plants (e.g. bark, fruit, leaves, nuts, seeds, tubers, roots, flowers), is very difficult since plant uses span both categories and this is deeply ingrained in the traditions and the fabric of the community (85). Thus, **Table 1** in this review captures both nutritional and medicinal references as they relate to Moringa, whilst avoiding most of the better known agro-forestry and water purification applications of this plant. The interested reader is also directed to the very comprehensive reviews of the nutritional attributes of Moringa prepared by the NGOs mentioned earlier (in particular, see references 47,123,157).

Phytochemistry

Phytochemicals are, in the strictest sense of the word, chemicals produced by plants. Commonly, though, the word 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. An examination of the phytochemicals of Moringa species affords the opportunity to examine a range of fairly unique compounds. In particular, this plant family is rich in compounds containing the simple sugar, rhamnose, and it is rich in a fairly unique group of compounds called glucosinolates and isothiocyanates (10,38). For example, specific components of Moringa preparations that have been reported to have hypotensive, anticancer, and antibacterial activity include 4-(4'-O-acetyl- α -L-rhamnopyranosyloxy)benzyl isothiocyanate [1], 4-(α -L-rhamnopyranosyloxy)benzyl isothiocyanate [2], niazimicin [3], pterygospermin [4], benzyl isothiocyanate [5], and 4-(α -L-rhamnopyranosyloxy)

benzyl glucosinolate [6]. While these compounds are relatively unique to the Moringa family, it is also rich in a number of vitamins and minerals as well as other more commonly recognized phytochemicals such as the

carotenoids (including β -carotene or pro-vitamin A). These attributes are all discussed extensively by Lowell Fuglie (47) and others, and will be the subject of a future review in this series.

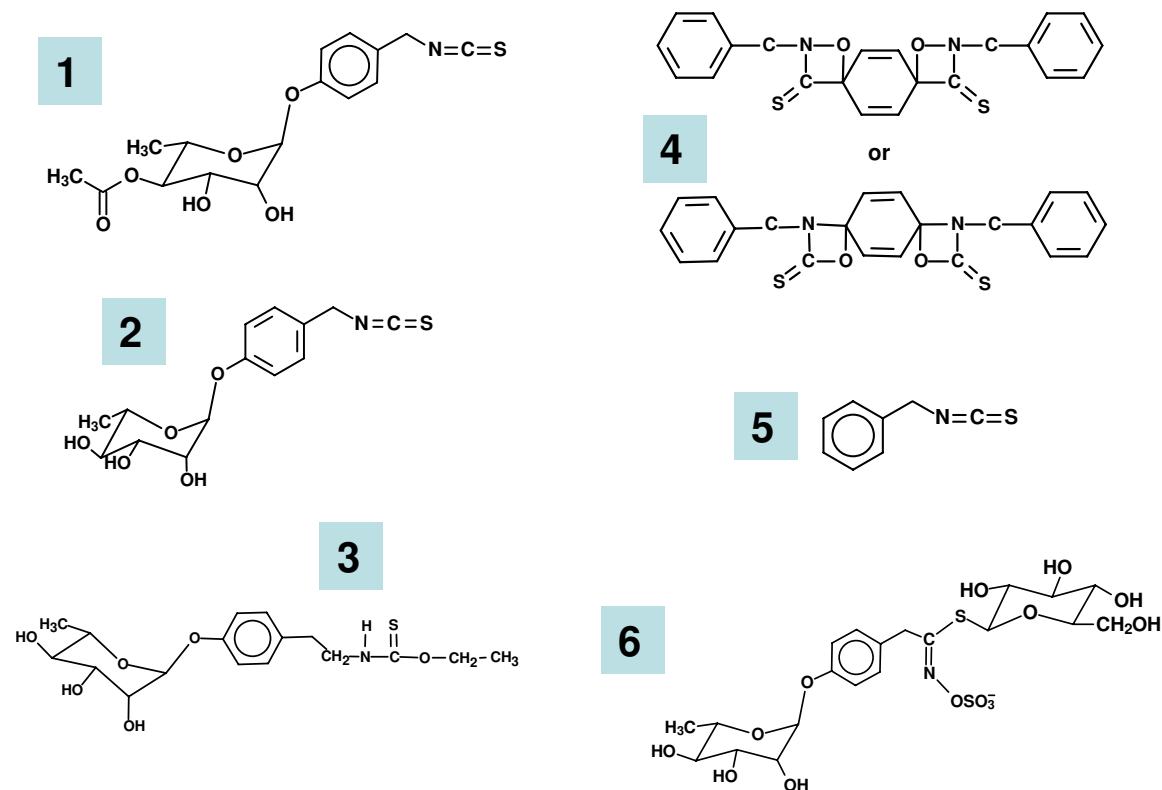


Figure 1. Structures of selected phytochemicals from *Moringa* spp.: 4-(4'-O-acetyl- α -L-rhamnopyranosyloxy)benzyl isothiocyanate [1], 4-(α -L-rhamnopyranosyloxy)benzyl isothiocyanate [2], niazimicin [3], pterygospermin [4], benzyl isothiocyanate [5], and 4-(α -L-rhamnopyranosyloxy)benzyl glucosinolate [6]

Disease Treatment and Prevention

The benefits for the treatment or prevention of disease or infection that may accrue from either dietary or topical administration of *Moringa* preparations (e.g. extracts, decoctions, poultices, creams, oils, emollients, salves, powders, porridges) are not quite so well known (116). Although the oral history here is also voluminous, it has been subject to much less intense scientific scrutiny, and it is useful to review the claims that have been made and to assess the quality of evidence available for the more well-documented claims. The readers of this review are encouraged to examine two recent papers that do an excellent job of contrasting the dilemma of balancing evidence from complementary and alternative medicine (e.g. traditional medicine,

tribal lore, oral histories and anecdotes) with the burden of proof required in order to make sound scientific judgments on the efficacy of these traditional cures (138,154). Clearly much more research is justified, but just as clearly this will be a very fruitful field of endeavor for both basic and applied researchers over the next decade.

Widespread claims of the medicinal effectiveness of various *Moringa* tree preparations have encouraged the author and his colleagues at The Johns Hopkins University to further investigate some of these possibilities. A plethora of traditional medicine references attest to its curative power, and scientific validation of these popular uses is developing to

support at least some of the claims. Moringa preparations have been cited in the scientific literature as having antibiotic, antitrypanosomal, hypotensive, antispasmodic, antiulcer, anti-inflammatory, hypocholesterolemic, and hypoglycemic activities, as well as having considerable efficacy in water purification by flocculation, sedimentation, antibiosis and even reduction of Schistosome cercariae titer (see **Table 1**).

Unfortunately, many of these reports of efficacy in human beings are not supported by placebo controlled, randomized clinical trials, nor have they been published in high visibility journals. For example, on the surface a report published almost 25 years ago (141) appears to establish Moringa as a powerful cure for urinary tract infection, but it provides the reader with no source of comparison (no control subjects). Thus, to the extent to which this is antithetical to Western medicine, Moringa has not yet been and will not be embraced by Western-trained medical practitioners for either its medicinal or nutritional properties.

In many cases, published *in-vitro* (cultured cells) and *in-vivo* (animal) trials do provide a degree of mechanistic support for some of the claims that have sprung from the traditional medicine lore. For example, 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 (39,40,76,131). I shall briefly introduce antibiosis and cancer prevention as just two examples of areas of Moringa research for which the existing scientific evidence appears to be particularly strong.

Antibiotic Activity. This is clearly the area in which the preponderance of evidence—both classical scientific and extensive anecdotal evidence—is overwhelming. The scientific evidence has now been available for over 50 years, although much of it is completely unknown to western scientists. In the late 1940's and early 1950's a team from the University of Bombay (BR Das), Travancore University (PA Kurup), and the Department of Biochemistry at the Indian Institute of Science in Bangalore (PLN Rao), identified a compound they called pterygospermin [4] a compound which they reported readily dissociated into two molecules of benzyl isothiocyanate [5] (23,24,25,26,77,78,79,80,81,108). Benzyl isothiocyanate was already understood at that time to have antimicrobial properties. This group not only identified pterygospermin, but performed extensive and elegant characterization of its mode of antimicrobial action in the mid 1950's. (They identified the tree from which they isolated this substance as "*Moringa pterygosperma*," now regarded as an archaic designation for "*M. oleifera*.") Although others were to show that pterygospermin and extracts of the Moringa plants from which it was isolated were antibacterial against a variety of microbes, the identity of pterygospermin has since been challenged (34) as an artifact of isolation or structural determination.

Subsequent elegant and very thorough work, published in 1964 as a PhD thesis by Bennie Badgett (a student of the well known chemist Martin Ettlinger), identified a number of glycosylated derivatives of benzyl isothiocyanate [5] (e.g. compounds containing the 6-carbon simple sugar, rhamnose) (8). The identity of these compounds was not available in the refereed scientific literature until "re-discovered" 15 years later by Kjaer and co-workers (73). Seminal reports on the antibiotic activity of the primary rhamnosylated compound then followed, from U Eilert and colleagues in Braunschweig, Germany (33,34). They re-isolated and confirmed the identity of 4-(α -L-rhamnopyranosyloxy)benzyl glucosinolate [6] and its cognate isothiocyanate [2] and verified the activity of the latter compound against a wide range of bacteria and fungi.

Extensive field reports and ecological studies (see **Table 1**) forming part of a rich traditional medicine history, claim efficacy of leaf, seed, root, bark, and flowers against a variety of dermal and internal infections. Unfortunately, many of the reports of antibiotic efficacy in humans are not supported by placebo controlled, randomized clinical trials. Again, in keeping with Western medical prejudices, practitioners may not be expected to embrace Moringa for its antibiotic properties. In this case, however, the *in-vitro* (bacterial cultures) and observational studies provide a very plausible mechanistic underpinning for the plethora of efficacy claims that have accumulated over the years (see **Table 1**).

Aware of the reported antibiotic activity of [2], [5], and other isothiocyanates and plants containing them, we undertook to determine whether some of them were also active as antibiotics against *Helicobacter pylori*. This bacterium was not discovered until the mid-1980's, a discovery for which the 2005 Nobel Prize in Medicine was just awarded. *H. pylori* is an omnipresent pathogen of human beings in medically underserved areas of the world, and amongst the poorest of poor populations worldwide. It is a major cause of gastritis, and of gastric and duodenal ulcers, and it is a major risk factor for gastric cancer (having been classified as a carcinogen by the W.H.O. in 1993). Cultures of *H. pylori*, it turned out, were extraordinarily susceptible to [2], and to a number of other isothiocyanates (37,60). These compounds had antibiotic activity against *H. pylori* at concentrations up to 1000-fold lower than those which had been used in earlier studies against a wide range of bacteria and fungi. The extension of this finding to human *H. pylori* infection is now being pursued in the clinic, and the prototypical isothiocyanate has already demonstrated some efficacy in pilot studies (49,168).

Cancer Prevention. Since *Moringa* species have long been recognized by folk medicine practitioners as having value in tumor therapy (61), we examined compounds [1] and [2] for their cancer preventive potential (39). Recently, [1] and the related compound [3] were shown to be potent inhibitors of phorbol ester

(TPA)-induced Epstein-Barr virus early antigen activation in lymphoblastoid (Burkitt's lymphoma) cells (57,104). In one of these studies, [3] also inhibited tumor promotion in a mouse two-stage DMBA-TPA tumor model (104). In an even more recent study, Bharali and colleagues have examined skin tumor prevention following ingestion of drumstick (*Moringa seedpod*) extracts (12). In this mouse model, which included appropriate positive and negative controls, a dramatic reduction in skin papillomas was demonstrated.

Thus, traditional practice has long suggested that cancer prevention and therapy may be achievable with native plants. Modern practitioners have used crude extracts and isolated bioactive compounds. The proof required by modern medicine has not been realized because neither the prevention of cancer nor the modification of relevant biomarkers of the protected

state has been adequately demonstrated in human subjects. Does this mean that it doesn't work? No. It may well work, but more rigorous study is required in order to achieve a level of proof required for full biomedical endorsement of *Moringa* as, in this case, a cancer preventative plant.

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TABLE 1. REPORTED NUTRITIONAL, THERAPEUTIC & PROPHYLACTIC USES OF *MORINGA OLEIFERA*

| Traditional Use Condition/Effect ^a | Plant Part ^b | References ^c |
|---|-------------------------|---|
| (ANT) Antimicrobial / Biocidal | LFSPRBGO | 8, 13, 19, 24, 27, 31, 34, 64, 68, 100, 104, 114, 115, 126, 140, 151, 160, 161, 162 |
| Bacterial | LFS | 25, 26, 55, 63, 77 - 81, 149 |
| Dental Caries/Toothache | RBG | 47 |
| Infection | LF | 47 |
| Syphilis | G | 47 |
| Typhoid | G | 47 |
| Urinary Tract Infection | L | 141 |
| Fungal/ Mycoses | O | 111 |
| Thrush | | 88, 111 |
| Viral | | |
| Common cold | FRB | 47 |
| Epstein-Barr Virus (EBV) | L | 104 |
| Herpes Simplex Virus (HSV-1) | L | 84 |
| HIV-AIDS | L | 1, 124 |
| Warts | S | 47 |
| Parasites | | |
| Dranunculiasis (guinea-worm) | | 36 |
| Helminths | LFP | 47 |
| Schistosomes | S | 113 |
| Trypanosomes | LR | 95 |
| Other / Not Attributed to a Specific Pathogen | | |
| Bronchitis | L | 47 |
| Earache | G | 47 |
| External Sores/Ulcers | LFRB | 15 |
| Fever | LRGS | 47 |
| Hepatic | L | 6 |
| Skin (Dermal) | O S | 15 |
| Throat Infection | F | 47 |
| Water treatment (general) | S | 11, 50, 75, 86, 169 |

| | | |
|--|---------------|---|
| AST Asthma | RG | 47 |
| CAN Cancer Therapy / Protection | LFPBS | 12, 17, 28, 39, 45, 59, 61, 64, 104, 115 |
| Anti-tumor | LFSB | 45, 48, 57, 61, 87 |
| Prostate | L | 47, 48 |
| Radioprotective | L | 132 |
| Skin | P | 12 |
| CIR Circulatory/Endocrine Disorders | LFSPR | 56, 93 |
| Anti-anemic | L | 47, 125 |
| Anti-hypertensive | LP | 40, 41, 42, 43, 44, 53, 83, 137 |
| Cardiotonic | R | 47 |
| Diabetes/hypoglycemia | LP | 6, 45, 71, 87, 101, 167 |
| Diuretic | LFRG | 6, 14, 62 |
| Hypocholestermia | L | 52, 94 |
| Thyroid | L | 153 |
| Tonic | F | 47 |
| Hepatorenal | LR | 93, 120 |
| DET Detoxification | BO | 76, 135, 166 |
| Antipyretic | | 148 |
| Purgative | O | 47 |
| Snakebite | B | 47 |
| Scorpion-bite | B | 47 |
| DIG Digestive Disorders | LSRBG | 53 |
| For TRTMNT of: | | |
| Colitis | LB | 47 |
| Diarrhea | LR | 47, 62, 64 |
| Digestif | B | 47 |
| Dysentery | LG | 47 |
| Flatulence | R | 47 |
| Ulcer / Gastritis | LS | 3, 115, 136 |
| INF Inflammation | LFSPRG | 14, 28, 35, 45, 62, 64, 68, 110, 131, 160, 161 |
| Rheumatism | LFSPRG | 28 |
| Joint Pain | P | 47 |
| Edema | R | 47 |
| Arthritis | S | 47 |
| IMM Immunity | SO | 69 |
| Immune-stimulant | S | 69 |
| Lupus | O | 28 |
| NER Nervous Disorders | LFRBGO | 58, 59, 62, 96 |
| Anti-spasmodic | SR | 14, 53 |
| Epilepsy | RB | 47 |
| Hysteria | FRBO | 47 |
| Headache | LRBG | 47 |
| NUT Nutritional | LSBO | 6, 7, 18, 22, 28, 30, 31, 32, 46, 47, 48, 51, 65, 66, 67, 70, 92, 102, 112, 116, 133, 163 |
| Antinutritional factors | B | 88, 89, 90, 110, 127, 128, 139, 156, 164, 165 |
| Antioxidant | LO | 110, 147 |
| Carotenoids | L | 29, 105, 152 |
| Energy | LSO | 85 |
| Goitrogen | S | 2 |
| Iron deficiency | LS | 16 |
| Oil quality | O | 5, 98, 110, 158, 159 |
| Protein | LS | 47 |
| Vitamin/Mineral deficiency | LS | 7, 9, 54, 56, 85, 119 |

| | | |
|---|----------------|---|
| REP Reproductive Health | LFPRBGO | 44, 53, 64, 121, 122 |
| Abortifacient | FRBG | 106, 107, 155 |
| Aphrodisiac | RB | 47 |
| Birth Control | B | 45, 53, 142 - 146, |
| Lactation Enhancer | L | 47 |
| Prostate function | O | 47 |
| SKI Skin Disorders | LRSB | 160, 161 |
| Antiseptic | L | 47 |
| Astringent | R | 47 |
| Pyoderma | S | 15 |
| Rubefacient | RG | 47 |
| Vesicant | R | 47 |
| GEN General Disorders/Conditions | LFSPRBO | 4, 6, 8, 20, 21, 45, 48, 64, 66, 67, 68, 73, 74, 82, 91, 92, 99, 102, 103, 109, 116, 117, 118, 123, 125, 128, 129, 130, 134, 150, 163 |
| Bladder | OS | 47 |
| Catarrh | LF | 47 |
| Gout | RO | 47 |
| Hepatamegaly | R | 47 |
| Lactation | L | 47 |
| Low.Back/Kidney Pain | R | 47 |
| Scurvy | LSRBO | 47 |
| Splenomegaly | R | 47 |
| "Tonic" | LFPSO | 47 |

^a It is very difficult in some cases to separate the effects of severe nutritional deficiencies (e.g. Vitamin C) from sequelae (e.g. scurvy) which transcend categorization by organ systems or classification into single disease states.

^b Plant parts are designated by their first letters (in bold):

Leaves
Flowers
Seeds
Pods (drumsticks)
Roots
Bark
Gum
Oil (from seeds)

^c Many of the original citations have been collected by Lowell J. Fuglie, [and can be found in his excellent treatise entitled [The Miracle Tree](#), (47)] and by Manuel Palada (116), Julia Morton (102), and Trees For Life (157). Most other compendiums in recent publications or on commercial websites appear to be highly derivative of these seminal works.

References

(3-letter code in yellow at end of reference indicates major classification in Table 1)

1. Abrams B, D Duncan, & I Hertz-Piccioto (1993) A prospective study of dietary intake and acquired immune deficiency syndrome in HIV-sero-positive homosexual men. *Journal of Acquired Immune Deficiency Syndrome*. 8: 949-958. **ANT**
2. Abuye C, AM Omwega, JK Imungi (1999) Familial tendency and dietary association of goitre in Gamo-Gofa, Ethiopia. *East African Medical Journal* 76:447-451. **NUT**
3. Akhtar AH, KU Ahmad (1995) Anti-ulcerogenic evaluation of the methanolic extracts of some indigenous medicinal plants of Pakistan in aspirin-ulcerated rats. *Journal of Ethnopharmacology* 46:1-6. **DIG**
4. Anderson DMW, PC Bell, et al. (1986). The gum exudates from *Chloroxylon swietenia*, *Sclerocarya caffra*, *Azadirachta indica* and *Moringa oleifera*. *Phytochemistry* 25(1): 247-249. **GEN**
5. 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. **NUT**
6. Asres K (1995) The major constituents of the acetone fraction of Ethiopian *Moringa stenopetala* leaves. *Mansoura Journal of Pharmacological Science* 11(1): 55-64. **ANT CIR NUT GEN**
7. 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. URL: <http://www.bib.fsagx.ac.be/library/base/text/v4n3/169.pdf>. **NUT**
8. Badgett BL (1964) Part I. The mustard oil glucoside from *Moringa oleifera* seed. Rice University PhD Thesis (student of Martin G. Ettlinger), Houston, TX, USA. **ANT GEN**
9. Barminas JT, M Charles, et al. (1998) Mineral composition of non-conventional leafy vegetables. *Plant Foods for Human Nutrition Dordrecht* 53(1): 29-36. **NUT**
10. Bennett RN, FA Mellon, N Foidl, JH Pratt, MS DuPont, L Perkins and PA Kroon (2003) Profiling glucosinolates and phenolics in vegetative and reproductive tissues of the multi-purpose trees *Moringa oleifera* L. (Horseradish tree) and *Moringa stenopetala* L. *Journal of Agricultural and Food Chemistry* 51: 3546-3553. **GEN**
11. Berger MR, M Habs, SA Jahn, S Schmahl (1984) Toxicological assessment of seeds from *Moringa oleifera* and *Moringa stenopetala*, two highly efficient primary coagulants for domestic water treatment of tropical raw waters. *East African Medical Journal* 61: 712-716. **ANT**
12. Bharali R, J Tabassum, MRH Azad (2003) Chemomodulatory effect of *Moringa oleifera*, Lam, on hepatic carcinogen metabolizing enzymes, antioxidant parameters and skin papillomagenesis in mice. *Asian Pacific Journal of Cancer Prevention* 4: 131-139. **CAN**
13. Caceres A, O Cabrera, O Morales, P Mollinedo, P Mendia (1991) Pharmacological properties of *Moringa oleifera*. 1: Preliminary screening for antimicrobial activity. *Journal of Ethnopharmacology* 33: 213-216. **ANT**
14. 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. **CIR INF NER**
15. Caceres A and S Lopez (1991) Pharmacological properties of *Moringa oleifera*: 3. Effect of seed extracts in the treatment of experimental pyoderma. *Fitoterapia* 62(5): 449-450. **ANT SKI**
16. Chawla S, A Saxena, et al. (1988) In-vitro availability of iron in various green leafy vegetables. *Journal of the Science of Food and Agriculture* 46(1): 125-128. **NUT**
17. 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. **CAN**
18. D'Souza J, AR Kulkarni (1993) Comparative studies on nutritive values of tender foliage of seedlings and mature plants of *Moringa oleifera* Lam. *Journal of Economic and Taxonomic Botany* 17(2): 479-485. **NUT**
19. Dahot MU (1998) Antimicrobial activity of small protein of *Moringa oleifera* leaves. *Journal of the Islamic Academy of Sciences* 11(1): 6 pp. **ANT**
20. Dahot MU, and AR Memon (1987) Properties of *Moringa oleifera* seed lipase. *Pakistan Journal of*

- Scientific and Industrial Research* 30(11): 832-835. **GEN**
21. Dahot MU, SA Ali, et al. (1985) Proteolytic enzymes of *Moringa oleifera* seeds. *Journal of Pharmacy* 6(1-2): 1-10. **GEN**
 22. Dahot MU, and AR Memon (1985) Nutritive significance of oil extracted from *Moringa oleifera* seeds. *Journal of Pharmacy of the University of Karachi* 3(2): 75-80. **NUT**
 23. Das BR, PA Kurup, and PL Narasimha Rao (1954) Antibiotic principle from *Moringa pterygosperma*. *Naturwissenschaften* 41: 66. **ANT**
 24. Das BR, PA Kurup, PL Narasimha Rao (1957) Antibiotic principle from *Moringa pterygosperma*. VII. Antibacterial activity and chemical structure of compounds related to pterygospermin. *Indian Journal of Medical Research* 45: 191-196. **ANT**
 25. Das BR, PA Kurup, and PL Narasimha Rao (1957) Antibiotic principle from *Moringa pterygosperma*. Part VII. Anti-bacterial activity and chemical structure of compounds related to pterygospermin. *Indian Journal of Medical Research* 45: 191-196. **ANT**
 26. Das BR, PA Kurup, PL Narasimha Rao, and AS Ramaswamy (1957) Antibiotic principle from *Moringa pterygosperma*. Part VIII. Some pharmacological properties and in vivo action of pterygospermin and related compounds. *Indian Journal of Medical Research* 45: 197-206. **ANT**
 27. 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. **ANT**
 28. Delaveau P, et al. (1980) Oils of *Moringa oleifera* and *Moringa drouhardii*. *Plantes Médicinales et Phytothérapie* 14(10): 29-33. **CAN NUT IMM INF**
 29. Delisle H, S Bakari, et al. (1997) Provitamin A content of traditional green leaves from Niger. *Cahiers Agricultures* 6(6): 553-560. **NUT**
 30. Dhar B, and OP Gupta (1982) Nutritional value of Shigru (*Moringa oleifera* Lam.). *B.M.E.B.R.* 3(2-4): 280-288. **NUT**
 31. 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. **ANT NUT GEN**
 32. ECHO (1996) *Moringa* Recipes. Echo Technical Note. Educational Concerns for Hunger Organization., N. Ft. Meyers, FL. URL: http://www.echotech.org/technical/technote_s/MoringaR.pdf. **NUT**
 33. Eilert U (1978) Antibiotic principles of seeds of *Moringa oleifera*. *Indian Medical Journal* 38(235): 1013-1016. **ANT**
 34. Eilert U, B Wolters, A Nahrstedt (1981) The antibiotic principle of seeds of *Moringa oleifera* and *Moringa stenopetala*. *Planta Medica* 42: 55-61. **ANT**
 35. Ezeamuzie IC, AW Ambakederemo, et al. (1996) Antiinflammatory effects of *Moringa oleifera* root extract. *International Journal of Pharmacognosy* 34(3): 207-212. **INF**
 36. Fabiyi JP, SL Kela, KM Tal, WA Istifanus (1993) Traditional therapy of dracunculiasis in the state of Bauchi - Nigeria. *Dakar Med.* 38:193-195. **ANT**
 37. Fahey JW, X Haristoy, PM Dolan, TW Kensler, I Scholtus, KK Stephenson, P Talalay, and A Lozniewski (2002) Sulforaphane inhibits extracellular, intracellular, and antibiotic-resistant strains of *Helicobacter pylori* and prevents benzo[a]pyrene-induced stomach tumors. *Proceedings of the National Academy of Sciences USA* 99: 7610-7615. **ANT CAN DIG**
 38. Fahey JW, AT Zalcmann, and P Talalay (2001) The chemical diversity and distribution of glucosinolates and isothiocyanates among plants. *Phytochemistry* 56(1): 5-51. [corrigendum: *Phytochemistry* 59: 237]. **ANT GEN**
 39. 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. **CAN**
 40. Faizi S, BS Siddiqui, R Saleem, S Siddiqui, K Aftab, and AH Gilani (1994) Isolation and structure elucidation of new nitrile and mustard oil glycosides from *Moringa oleifera* and their effect on blood pressure. *Journal of Natural Products* 57: 1256-1261. **CIR**
 41. Faizi S, et al. (1994) Novel hypotensive agents, niazimin A, niazimin B, niazicin A and niazicin B from *Moringa oleifera*: Isolation of first naturally occurring carbamates. *Journal of the Chemical Society Perkin Transactions I*: 3035-3040. **CIR**
 42. Faizi S, BS Siddiqui, et al. (1992) Isolation and structure elucidation of novel hypotensive agents, niazinin A, niazinin B, niazimicin and niaziminin A plus B from *Moringa oleifera*: The

- first naturally occurring thiocarbamates. *Journal of the Chemical Society Perkin Transactions I*(23): 3237-3241. **CIR**
43. Faizi S, BS Siddiqui, R Saleem, S Siddiqui, K Aftab, AH Gilani (1995) Fully acetylated carbamate and hypotensive thiocarbamate glycosides from *Moringa oleifera*. *Phytochemistry* 38: 957-963. **CIR**
 44. 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. **CIR REP**
 45. Faizi S, et al. (1998) Bioactive Compounds from the leaves and pods of *Moringa oleifera*. *New Trends in Natural Products Chemistry* 175-183. **CAN CIR GEN INF**
 46. Freiburger CE, DJ Vanderjagt, et al. (1998) Nutrient content of the edible leaves of seven wild plants from Niger. *Plant Foods for Human Nutrition* 53(1): 57-69. **NUT**
 47. 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. http://www.echotech.org/bookstore/advanced_search_result.php?keywords=Miracle+Tree. **ANT AST CIR DET DIG INF NER NUT REP SKI**
 48. Fuglie LJ (2000) *New Uses of Moringa Studied in Nicaragua*. ECHO Development Notes #68, June, 2000. <http://www.echotech.org/network/modules.php?name=News&file=article&sid=194>. **GEN NUT**
 49. 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.
 50. 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. **ANT**
 51. Geervani P, and A Devi (1981) Influence of protein and fat on the utilisation of carotene from drumstick (*Moringa oleifera*) leaves. *Indian Journal of Medical Research* 74: 548-553. **NUT**
 52. 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. **CIR**
 53. 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. **CIR NER REP**
 54. Girija V, D Sharada, and P Pushpamma (1982) Bioavailability of thiamine, riboflavin and niacin from commonly consumed green leafy vegetables in the rural areas of Andhra Pradesh in India. *International Journal of Vitamin & Nutrition Research* 52: 9-13. **NUT**
 55. Gopalakrishna KS, PA Kurup and PL Narashimha Rao (1954) Antibiotic principles from *Moringa pterygosperma*. Part III. Action of pterygospermin on germination of seeds and filamentous fungi. *Indian Journal of Medical Research* 42: 97-99. **ANT**
 56. Grant G, LJ More, et al. (1995) Nutritional and haemagglutination properties of several tropical seeds. *Journal of Agricultural Science* 124(3): 437-445. **CIR NUT**
 57. Guevara AP, C Vargas, H Sakurai, Y Fujiwara, K Hashimoto, T Maoka, M Kozuka, Y Ito, H Tokuda, and H Nishino (1999) An antitumor promoter from *Moringa oleifera* Lam. *Mutation Research* 440: 181-188. **CAN**
 58. Gupta M, UK Mazumder, et al. (1999) CNS activities of methanolic extract of *Moringa oleifera* root in mice. *Fitoterapia* 70(3): 244-250. **NER**
 59. Gupta M, UK Mazumder, et al. (1997) Anti-epileptic and anti-cancer activity of some indigenous plants. *Indian Journal of Physiology and Allied Sciences* 51(2): 53-56. **CAN NER**
 60. 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. **ANT**
 61. Hartwell JL. 1967-1971. Plants used against cancer: a survey. *Lloydia* 30-34. **CAN**
 62. Hameed-Un-Nisa L, D Shehnaz, and S Faizi (1998) Measurement of sympatholytic activity of *Moringa oleifera*. *New Trends in Natural Products Chemistry* [6th International Symposium on Natural Products Chemistry] 269-277. Harwood Amsterdam. **NER CIR DIG INF**
 63. Holst S. (2000). *Moringa: Nature's Medicine Cabinet*. Sierra Sunrise Publishing, Sherman Oaks, CA. 128 pp. **GEN**
 64. Jadhav SL, SR Sharma, SC Pal, SB Kasture, and VS Kasture (2000) Chemistry and pharmacology of *Moringa oleifera* and *Moringa*

- concanescens* Niro. *Indian Drugs* 37(3): 139-144. **ANT CAN DIG INF REP**
65. Jahn SA (1991) The traditional domestication of a multipurpose tree *Moringa stenopetala* (Bak.f.) Cuf. in the Ethiopian Rift Valley. *AMBIO* 20: 244-247. **NUT GEN**
 66. Jahn SA, HA Musnad and H Burgstaller (1986) Tree that purifies water: Cultivating multipurpose Moringaceae in the Sudan. *Unasylva* 38(152): 23-28. http://www.fao.org/documents/show_cdr.asp?url_file=/docrep/r7750e/r7750e04.htm. **NUT GEN**
 67. Jahn SAA (1996) On the introduction of a tropical multipurpose tree to China traditional and potential utilisation of *Moringa oleifera* Lamark. *Senckenbergiana Biologica* 75(1-2): 243-254. **NUT GEN**
 68. Jacquat C, and G Bertossa (1990) Plants from the Markets of Thailand. Editions Duang Kamol, Bangkok. p. 38 **ANT GEN INF**
 69. Jayavardhanan KK, K Suresh, KR Panikkar, and DM Vasudevan (1994) Modulatory potency of drumstick lectin on the host defense system. *Journal of Experimental Clinical Cancer Research* 13(3): 205-209. **IMM**
 70. 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: 1-5. http://www.koshealthpub.com/articles/pdf/Clinical_Perspectives_Moringa_Aug-05.pdf. **NUT GEN**
 71. Kar A, BK Choudhary, et al. (1999) Preliminary studies on the inorganic constituents of some indigenous hypoglycaemic herbs on oral glucose tolerance test. *Journal of Ethnopharmacology* 64(2): 179-184. **CIR**
 72. Kar A, B Choudhary, and N Bandyopadhyay (2003) Comparative evaluation of hypoglycaemic activity of some Indian medicinal plants in alloxan diabetic rats. *Journal of Ethnopharmacology* 84(1): 105-108. **CIR**
 73. Kjaer A, O Malver, B El-Menshawi, and J Reisch (1979) Isothiocyanates in myrosinase-treated seed extracts of *Moringa peregrina*. *Phytochemistry* 18: 1485-1487. **GEN**
 74. Kumar K, and AK Goel (1999) Frequently used ethno-medicinal plants of Bihar. *Journal of Economic and Taxonomic Botany* 23(2): 645-649. **GEN**
 75. 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. **ANT**
 76. Kumar NA, and L Pari (2003) Antioxidant action of *Moringa oleifera* Lam. (drumstick) against antitubercular drugs induced lipid peroxidation in rats. *Journal of Medicinal Food* 6(3): 255-259. **DET**
 77. Kurup PA and PL Narasimha Rao. (1952) Antibiotic principle from *Moringa pterygosperma*. Part I. *Journal of the Indian Institute of Science* 34: 219-227. **ANT**
 78. Kurup PA and PL Narasimha Rao. (1954) Antibiotic principle from *Moringa pterygosperma*. Part II. Chemical nature of pterygospermin. *Indian Journal of Medical Research* 42: 85-95. **ANT**
 79. Kurup PA and PL Narasimha Rao. (1954) Antibiotic principle from *Moringa pterygosperma*. Part IV. The effect of addition of vitamins and amino acids on the anti-bacterial activity of pterygospermin. *Indian Journal of Medical Research* 42: 101-107. **ANT**
 80. Kurup PA and PL Narasimha Rao. (1954) Antibiotic principle from *Moringa pterygosperma*. Part V. Effect of pterygospermin on the assimilation of glutamic acid by *Micrococcus pyogenes* var. *aureus*. *Indian Journal of Medical Research* 42: 109-114. **ANT**
 81. Kurup PA, PL Narasimha Rao and R Venkataraman. (1954) Antibiotic principle from *Moringa pterygosperma*. Part VI. Mechanism of anti-bacterial action of pterygospermin inhibition of transaminase by pterygospermin. *Indian Journal of Medical Research* 42: 115-123. **ANT**
 82. Leuck M, and H Kunz (1998) Synthesis of active principles from the leaves of *Moringa oleifera* using S-pent-4-enyl thioglycosides. *Carbohydrate Research* 312(1-2): 33-44. **GEN**
 83. Limaye DA, AY Nimbkar, R Jain, and M Ahmad (1995) Cardiovascular effects of the aqueous extract of *Moringa pterygosperma*. *Phytotherapy Research* 9: 37-40. **CIR**
 84. 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. **ANT**
 85. Lockett, C. T., C. C. Calvert, et al. (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. **NUT**
86. Madsen M, J Schlundt, and EF Omer (1987) Effect of water coagulation by seeds of *Moringa oleifera* on bacterial concentrations. *Journal of Tropical Medicine and Hygiene* 90: 101-109. **ANT**
 87. Makonnen E, A Hunde, G Damecha (1997) Hypoglycaemic effect of *Moringa stenopetala* aqueous extract in rabbits. *Phytotherapy Research* 11: 147-148. **CIR**
 88. Makkar HPS, and K Becker (1999) Plant toxins and detoxification methods to improve feed quality of tropical seeds. *Asian Australasian Journal of Animal Sciences* 12(3): 467-480. **NUT**
 89. Makkar HPS, and K Becker (1997) Nutrients and antiquality factors in different morphological parts of the *Moringa oleifera* tree. *Journal of Agricultural Science* 128(3): 311-322. **NUT**
 90. Makkar HPS, and K Becker (1996) Nutritional value and antinutritional components of whole and ethanol extracted *Moringa oleifera* leaves. *Animal Feed Science and Technology* 63(1-4): 211-228. **NUT**
 91. Marcu MG. 2005. Miracle Tree. KOS Health Publications, La Canada, CA. 172 pp. **GEN**
 92. Martin FW, RM Ruberte, and LS Meitzner (1998) Edible Leaves of the Tropics. 3rd Ed. Educational Concerns for Hunger Organization, Inc., N. Ft. Meyers, FL. 194 pp. **NUT GEN**
 93. Mazumder UK, M Gupta, et al. (1999) Evaluation of hematological and hepatorenal functions of methanolic extract of *Moringa oleifera* Lam. root treated mice. *Indian Journal of Experimental Biology*. 37(6): 612-614. **CIR**
 94. Mehta LK, R Balaraman, AH Amin, PA Bafna and OD Gulati (2003) Effect of fruits of *Moringa oleifera* on the lipid profile of normal and hypocholesterolaemic rabbits. *Journal of Ethnopharmacology* 86: 191-195. **CIR**
 95. Mekonnen Y, V Yardley, P Rock, S Croft (1999) In vitro antitrypanosomal activity of *Moringa stenopetala* leaves and roots. *Phytotherapy Research* 13: 538-539. **ANT**
 96. Mekonnen Y (1999) Effects of ethanol extract of *Moringa stenopetala* leaves on guinea-pig and mouse smooth muscle. *Phytotherapy Research* 13: 442-444. **NER**
 97. Mekonnen Y, and B Drager (2003) Glucosinolates in *Moringa stenopetala*. *Planta Med.* 69: 380-382. **GEN**
 98. Memon GM, and LM Khatri (1987) Isolation and spectroscopic studies of mono-palmitic, di-oleic triglyceride from seeds of *Moringa oleifera* Lam. *Pakistan Journal of Scientific and Industrial Research* 30(5): 393-395. **NUT**
 99. Memon GM, SA Memon, et al. (1985) Isolation and structure elucidation of moringyne: A new glycoside from seeds of *Moringa oleifera*. *Pakistan Journal of Scientific and Industrial Research* 28(1): 7-9. **GEN**
 100. Monzon RB (1995) Traditional medicine in the treatment of parasitic diseases in the Philippines. *Southeast Asian Journal of Tropical Medicine and Public Health* 26(3): 421-428. **ANT**
 101. Mossa JS (1985) A study on the crude antidiabetic drugs used in Arabian folk medicine. *International Journal of Crude Drug Research* 23(3): 137-145. **CIR**
 102. Morton JF (1991) The horseradish tree, *Moringa pterygosperma* (Moringaceae) – A boon to arid lands? *Economic Botany* 45: 318-333. **NUT GEN**
 103. Muluvi GM, JI Sprent, N Soranzo, J Provan, D Odee, G Folkard, JW McNicol, and W Powell (1999) Amplified fragment length polymorphism (AFLP) analysis of genetic variation in *Moringa oleifera* Lam. *Molecular Ecology* 8: 463-470. **GEN**
 104. Murakami A, Y Kitazono, S Jiwajinda, K Koshimizu, and H Ohigashi (1998) Niaziminin, a thiocarbamate from the leaves of *Moringa oleifera*, holds a strict structural requirement for inhibition of tumor-promoter- induced Epstein-Barr virus activation. *Planta Medica* 64: 319-323. **ANT CAN**
 105. Nambear, et al. (2001) Bioavailability trials of beta-carotene from fresh and dehydrated leaves of *Moringa oleifera* in a rat model. *Plant Foods and Human Nutrition* 56(1): 83-95. **NUT**
 106. Nath D, N Sethi, RK Singh, AK Jain (1992) Commonly used Indian abortifacient plants with special reference to their teratologic effects in rats. *Journal of Ethnopharmacology* 36: 147-154. **REP**
 107. Nath D, N Sethi, et al. (1997) Survey on indigenous medicinal plants used for abortion in some districts of Uttar Pradesh. *Fitoterapia* 68(3): 223-225. **REP**
 108. Narasimha Rao PI, and PA Kurup (1953) Pterygospermin – the antibiotic principle of *Moringa pterygosperma* Gaertn.. *Indian Journal of Pharmacy* 15(12): 315. **ANT**

109. Nautiyal BP, and KG Venkataraman (1987) Moringa (Drumstick) – An ideal tree for social forestry: Growing conditions and uses – Part I. *MYFOREST* 23(1): 53-58. **GEN**
110. Njoku OU, and MU Adikwu (1997) Investigation on some physico-chemical antioxidant and toxicological properties of *Moringa oleifera* seed oil. *Acta Pharmaceutica Zagreb* 47(4): 287-290. **DET INF NUT**
111. Nwosu MO, JI Okafor (1995) Preliminary studies of the antifungal activities of some medicinal plants against *Basidiobolus* and some other pathogenic fungi. *Mycoses* 38: 191-195. **ANT**
112. 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. **NUT**
113. Olsen A (1987) Low technology water purification by bentonite clay and *Moringa oleifera* seed flocculation as performed in Sudanese villages. Effects on *Schistosoma mansoni* cercariae. *Water Research* 21(5): 517-522. **ANT**
114. Pal SK, PK Mukherjee, K Saha, M Pal and BP Saha (1995) Antimicrobial action of the leaf extract of *Moringa oleifera* Lam. *Ancient Science of Life* 14(3): 197-199. **ANT**
115. Pal SK, PK Mukherjee, and BP Saha (1995) Studies on the antiulcer activity of *Moringa oleifera* leaf extract on gastric ulcer models in rats. *Phytotherapy Research* 9: 463-465. **CAN DIG**
116. Palada MC (1996). Moringa (*Moringa oleifera* Lam.): A versatile tree crop with horticultural potential in the subtropical United States. *HortScience* 31, 794-797. **NUT GEN**
117. Palada MC, and LC Chang (2003) Suggested cultivation practices for Moringa. AVRDC Publication #03-545; <http://www.avrdc.org/LC/indigenous/moringa.pdf> **GEN**
118. Palaniswamy U (2005) Purslane—Drumsticks *Lok-Vani* (e-journal) http://www.lokvani.com/lokvani/article.php?article_id=1836 **NUT GEN**
119. Pankaja N, J Prakash (1994) Availability of calcium from kilkeerai (*Amaranthus tricolor*) and drumstick (*Moringa oleifera*) greens in weanling rats. *Nahrung* 38: 199-203. **NUT**
120. Pari L and NA Kumar (2002) Hepatoprotective activity of *Moringa oleifera* on antitubercular drug-induced liver damage in rats. *Journal of Medical Foods* 5(3): 171-177. **DET**
121. Prakash AO, S Pathak, S Shukla, R Mathur (1987) Uterine histoarchitecture during pre and post-implantation periods of rats treated with aqueous extract of *Moringa oleifera* Lam. *Acta Europaea Fertilitatis* 18: 129-135. **REP**
122. Prakash AO (1988) Ovarian response to aqueous extract of *Moringa oleifera* during early pregnancy in rats. *Fitoterapia* 59(2): 89-96. **REP**
123. Price ML (1985) The Moringa Tree. ECHO Technical Note. Educational Concerns for Hunger Organization, N. Ft. Meyers, FL. <http://www.echotech.org/technical/technotes/moringabiomasa.pdf>. **GEN**
124. Prazuk T, et al. (1993) HIV infection and severe malnutrition: A clinical epidemiology study in Burkina Faso. *AIDS* 7: 103-108. **ANT**
125. Quisumbing E (1978) Medicinal Plants of the Philippines. Katha Publishing Co., Inc., Quezon City. pp 346-349. **GEN**
126. Rajendhran J, MA Mani, et al. (1998) Antibacterial activity of some selected medicinal plants. *Geobios Jodhpur* 25(4): 280-282. **ANT**
127. Ram J (1994) Moringa a highly nutritious vegetable tree, Tropical Rural and Island/Atoll Development Experimental Station (TRIADES), Technical Bulletin No.2. **NUT**
128. Ramachandran C, KV Peter, and PK Gopalakrishnan (1980) Drumstick (*Moringa oleifera*): A multipurpose Indian Vegetable. *Economic Botany* 34(3): 276-283. **NUT GEN**
129. Rao Kurma S, and SH Mishra (1993) Drumstick polysaccharide as pharmaceutical adjuvant. *Indian Journal of Natural Products* 9(1): 3-6. **GEN**
130. Rao PP, BM Acharya and TJ Dennis (1996) Pharmacognostic study on stem bark of *Moringa oleifera* Lam. (Sigru). *B.M.E.B.R.* 17(3-4): 141-151. **ANT GEN**
131. Rao KNV, V Gopalakrishnan, V Loganathan, and S Shanmuganathan (1999) Antiinflammatory activity of *Moringa oleifera* Lam. *Ancient Science of Life* 18(3-4): 195-198. **INF**
132. Rao AV, PU Devi, and R Kamath (2001) In vivo radioprotective effect of *Moringa oleifera* leaves. *Indian Journal of Experimental Biology* 39: 858-863. **CAN**
133. Reddy NS, and G Bhatt (2001) Contents of minerals in green leafy vegetables cultivated in soil fortified with different chemical fertilizers. *Plant Foods for Human Nutrition* 56: 1-6. **NUT**

134. Ross IA (1999) Medicinal Plants of the World. Humana Press, Inc., Totowa, NJ. pp 231-239. **GEN**
135. Ruckmani K, S Kavimani, et al. (1998) Effect of *Moringa oleifera* Lam. on paracetamol-induced hepatotoxicity. *Indian Journal of Pharmaceutical Sciences* 60(1): 33-35. **DET**
136. Ruckmani K, S Davimani, B Jayakar, and R Anandan (1998) Anti-ulcer activity of the alkali preparation of the root and fresh leaf juice of *Moringa oleifera* Lam. *Ancient Science of Life* 17(3): 220-223. **DIG**
137. Saleem R, and J Meinwald (2000) Synthesis of novel hypotensive aromatic thiocarbamate glycosides. *Journal of the Chemical Society Perkins Transactions 1*: 391-394. **CIR**
138. Sampson W (2005) Studying herbal remedies. *New England Journal of Medicine* 353(4): 337-339.
139. Sena LP, DJ Vanderjagt, C Rivera, AT Tsin, I Muhamadu, O Mahamadou, M Millson, A Pastuszyn, and RH Glew (1998) Analysis of nutritional components of eight famine foods of the Republic of Niger. *Plant Foods and Human Nutrition* 52: 17-30. **NUT**
140. Sen Gupta KP, NC Ganguli, and B Bhattacharjee (1956) Bacteriological and pharmacological studies of a vibriocidal drug derived from an indigenous source. *The Antiseptic* 53(4): 287-292. **ANT**
141. Shaw BP, and P Jana (1982) Clinical assessment of Sigru (*Moringa oelifera* Lam) on Mutrakrichra (lower urinary tract infection) NAGARJUN 231-235. **ANT**
142. Shukla S, R Mathur, AO Prakash (1988) Biochemical and physiological alterations in female reproductive organs of cyclic rats treated with aqueous extract of *Moringa oleifera* Lam. *Acta Europaea Fertilitatis* 19: 225-232. **REP**
143. Shukla S, R Mathur, et al. (1988) Anti-implantation efficacy of *Moringa oleifera* Lam. and *Moringa concanensis* Nimmo in rats. *International Journal Of Crude Drug Research* 26(1): 29-32. **REP**
144. Shukla S, R Mathur, and AO Prakash (1988) Antifertility profile of the aqueous extract of *Moringa oleifera* roots. *Journal of Ethnopharmacology* 22: 51-62. **REP**
145. Shukla S, R Mathur, AO Prakash (1989) Histoarchitecture of the genital tract of ovariectomized rats treated with an aqueous extract of *Moringa oleifera* roots. *Journal of Ethnopharmacology* 25: 249-261. **REP**
146. Shukla S, R Mathur, et al. (1989) Biochemical alterations in the female genital tract of ovariectomized rats treated with aqueous extract of *Moringa oleifera* Lam. *Pakistan Journal of Scientific and Industrial Research* 32(4): 273-277. **REP**
147. Siddhuraju P, and K Becker (2003) Antioxidant properties of various solvent extracts of total phenolic constituents from three different agroclimatic origins of drumstick tree (*Moringa oleifera* Lam.) leaves. *Journal of Agricultural and Food Chemistry* 51: 2144-2155. **NUT**
148. Singh KK, and K Kumar (1999) Ethnotherapeutics of some medicinal plants used as antipyretic agents among the tribals of India. *Journal of Economic and Taxonomic Botany*. 23(1): 135-141. **DET**
149. Singha P, J Begum, et al. (1993) Antibacterial activity of some higher plants of Chittagong University Campus. Chittagong University Studies Part II Science 17(1): 97-101. **ANT**
150. Soni PL (1995) Some commercially important Indian gum exudates. *Indian Forester* 121(8): 754-759. **GEN**
151. Spiliotis V, S Lalas, et al. (1998) Comparison of antimicrobial activity of seeds of different *Moringa oleifera* varieties. *Pharmaceutical and Pharmacological Letters* 8(1): 39-40. **ANT**
152. Subadra S, J Monica, et al. (1997) Retention and storage stability of beta-carotene in dehydrated drumstick leaves (*Moringa oleifera*). *International Journal of Food Sciences and Nutrition* 48(6): 373-379. **NUT**
153. Tahiliani P, A Kar (2000) Role of *Moringa oleifera* leaf extract in the regulation of thyroid hormone status in adult male and female rats. *Pharmacological Research* 41(3):319-323. **CIR**
154. Talalay P, and P Talalay (2001) The importance of using scientific principles in the development of medicinal agents from plants. *Academic Medicine* 76(3): 238-247.
155. Tarafder CR (1983) Ethnogyneology in relation to plants: 2. Plants used for abortion. *Journal of Economic and Taxonomic Botany* 4(2): 507-516. **REP**
156. Terra, G.J.A. 1966. Tropical vegetables, vegetable growing in the tropics and subtropics especially of indigenous vegetables. Communications No. 54e of the Department of Agricultural Research; Publication of the Royal Tropical Institute, Amsterdam, The Netherlands. **NUT**

157. Trees For Life (2005) Moringa Book. <http://www.treesforlife.org/project/moringa/book/default.asp>. **NUT GEN**
158. Tsaknis J, S Lalas, V Gergis, V Douroglou, and V Spiliotis (1999) Characterization of *Moringa oleifera* variety Mbololo seed oil of Kenya. *Journal of Agricultural and Food Chemistry* 47: 4495-4499. **NUT**
159. Tsaknis J, V Spiliotis, et al. (1999) Quality changes of *Moringa oleifera*, variety Mbololo of Kenya, seed oil during frying. *Grasas y Aceites*. 50(1): 37-48. **NUT**
160. Udupa SL, AL Udupa, et al. (1998) A comparative study on the effect of some indigenous drugs on normal and steroid-depressed healing. *Fitoterapia* 69(6): 507-510. **ANT INF SKI**
161. Udupa SL, AL Udupa, et al. (1994) Studies on the anti-inflammatory and wound healing properties of *Moringa oleifera* and *Aegle marmelos*. *Fitoterapia* 65(2): 119-123. **ANT INF SKI**
162. Villasenor IM (1994) Bioactive metabolites from *Moringa oleifera* Lam. *KIMIKA* 10: 47-52. **ANT**
163. Verdcourt B (1985) A synopsis of the Moringaceae. *Kew Bulletin* 40: 1-23. **NUT GEN**
164. Villasenor IM, CY Lim-Sylianco, and F Dayrit (1989) Mutagens from roasted seeds of *Moringa oleifera*. *Mutation Research* 224: 209-212. **NUT**
165. Villasenor IM, P Finch, CY Lim-Sylianco, F Dayrit (1989) Structure of a mutagen from roasted seeds of *Moringa oleifera*. *Carcinogenesis* 10: 1085-1087. **NUT**
166. Warhurst AM, SL Raggett, GL McConnachie, SJT Pollard, V Chipofya, and GA Codd (1997) Adsorption of the cyanobacterial hepatotoxin Microcystin-LR by a low-cost activated carbon from the seed husks of the pantropical tree, *Moringa oleifera*. *The Science of the Total Environment* 207: 207-211. **DET**
167. William F, S Lakshminarayanan, et al. (1993) Effect of some Indian vegetables on the glucose and insulin response in diabetic subjects. *International Journal of Food Sciences and Nutrition* 44(3): 191-196. **CIR**
168. Yanaka A, S Zhang, M Yamamoto, JW Fahey (2005) Daily intake of sulforaphane-rich broccoli sprouts improves gastritis in *H.pylori*-infected human subjects. *Cancer Epidemiology Biomarkers and Prevention* 14(11, Suppl): 2754s.
169. 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. **ANT**