

anamed Moringa Reader

*Moringa -
is it really
capable
of miracles?*



Papers and experiences about *Moringa oleifera* and *Moringa stenopetala*

The moringa tree can make a massive contribution to good health

We hope this document will encourage you to plant many moringa trees, and to use

- the leaves as food to combat malnutrition; they contain vitamins, proteins and minerals.
- the seeds to purify water, because they are a natural coagulant.
- the leaves especially, but also the flowers, seeds and roots, as medicine.

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Contents

1. A conversation with Hans-Martin Hirt, founder of <i>anamed</i>	2
2. <i>Moringa oleifera</i> : Recognition	4
3. Moringa: propagation and cultivation	5
4. Moringa seed oil	8
5. To make moringa leaf powder	9
6. Nutritional properties of moringa	10
7. Moringa in anamed medicine: Experiences	14
8. Moringa in the anamed pharmacy: Suggestions for the preparation of medicines	16
9. Use of Moringa in agriculture and with livestock	17
10. Field guide for emergency water treatment with <i>Moringa oleifera</i>	19
11. A summary of other non-medicinal benefits of moringa	21
12. Design for a possible flyer about Moringa	21
13. Case study: Senegal	24
14. Case study: Ghana	25
15. <i>Moringa oleifera</i> – from the database of the World Agroforestry Centre	26
16. <i>Moringa stenopetala</i> - from the database of the World Agroforestry Centre	28
17. A comparison of <i>Moringa oleifera</i> and <i>Moringa stenopetala</i>	30
18. Phytochemical constituents and research studies	31
19. Bibliography – sources of more information	33

Introduction

Thirteen different species of moringa are known. This document is about just two; *Moringa oleifera* and *Moringa stenopetala*. *Moringa oleifera* was originally native to India, but is now widely distributed throughout the Tropics. *Moringa oleifera* is also known as the Horseradish tree, Radish tree, Drumstick tree, Mother's Best Friend, West Indian ben....

Moringa stenopetala is native to Ethiopia, and is slowly spreading into other parts of Africa. Both have very similar nutritional and medicinal properties.

In many places moringa is known, but its remarkable properties are not known. This document has been written with the aim of helping many more families, communities and health centres to benefit from its health giving properties. This document was written by Dr. Keith Lindsey and Dr. Hans-Martin Hirt.

We acknowledge with thanks the contribution to this document of the drawings of the Kinshasa artist Bindanda Tsohi. We encourage you to photocopy this document and use it to teach others about moringa!

1. A conversation with Hans-Martin Hirt, founder of *anamed*

Visitor: *When so much medical research has been conducted and there are such excellent modern medicines available, why do you still talk with people in the Tropics about the “weeds” in their back yards?*

H-M H: *What you say is true, but the hard fact of life is that these modern drugs are just not available in many regions of Africa and Asia. Where they are available, they are often far too expensive for people to afford. But more surprisingly, in spite of all the millions that have been spent on research, there are some herbal remedies that are actually more effective than any modern treatment.*

Visitor: *That is remarkable. Can you give me an example?*

H-M H: *Go into a pharmacy, and ask for one tablet that will reduce both high blood pressure and the blood sugar level, help one to sleep, give energy and appetite and whose constituents are patented for use with cancer and AIDS. Your pharmacist will throw up his hands in despair but the solution is quite straight forward!*

Visitor: *Moringa! What is it about moringa that is so special?*

H-M H: *Moringa has quite justifiably become very popular. I say that whoever needs a food supplement should take moringa, simply as leaf powder, not as a capsule – capsules are only about making money! Every year 8 million children are born dead or die in the first months of their lives. The majority of these families are poor, and in such families the mothers and children are almost always undernourished, if not malnourished. With moringa one will never become rich, but one can become healthy.*

Visitor: *I have heard that in parts of Sudan people uproot it as a weed.*

H-M H: *In wanting to become modern even the Sudanese are losing their traditional knowledge. In the internet moringa leaf powder can be bought for 240 Euro per kilo – that corresponds to the yearly income of a rural Sudanese! In Sudan I met a refugee who for 2 long years had fled on foot from South Sudan to Ethiopia, from there to Kenya and then back to South Sudan – without money. In this time he and his family had fed themselves almost entirely from leaves, and particularly from moringa.*

Visitor: *Can one really eat moringa leaves?*

H-M H: *Moringa leaves are very unusual because they can be eaten directly. We could eat like giraffes! They contain vitamins, proteins and minerals – they are comparable even to eggs! The usual way to eat them is to collect the leaves, dry them and make them into a powder, and then this powder is added to porridge or stirred into any other meal. The flowers, seeds, pods and roots are also useful.*

Visitor: *There have been many other programmes to combat malnutrition, but the problem persists. Can moringa be any more successful than other programmes?*

H-M H: *Most other programmes have depended on imported foods such as milk powder and sugar. Then the funding dries up, or corruption plays too big a role as the local staff demand good payment, or the project computers are infected by viruses or maybe even a termite’s nest - and the supply of nutritional supplements dries up. Moringa on the other hand grows and grows, families can become quite independent of donors, moringa even*

survives drought. Thus each family that has a little bit of land can have a moringa tree right outside their door. In parts of southern Ethiopia, each family usually has a moringa tree in their garden, and cooks the leaves as a vegetable at least once a week. So you see, if people grow moringa, they do not depend on any import, or any agency, from outside. They are much more independent. I would like to see every family in the Tropics having 10 moringa trees in their garden!

Visitor, Mr Hirt, you are a pharmacist, what is the connection between moringa and disease?

H-M H: A lot, alone in the USA 45 patents involving moringa have been registered, for example as a fungal treatment, for water clarification, for natural AIDS therapy, for high blood pressure, as antibiotic, for diabetes, for protection of the liver, to increase the supply of breast milk, for inflammation, for wound healing, as a diuretic, for tumours. anamed patents nothing, but these patents show us the areas in which moringa treatments may be most effective.

Visitor: Did I hear you say that moringa is also important because of global warming? How can that be?

H-M H: Like any tree, moringa takes carbon dioxide from the atmosphere. Global warming affects poor countries much more than rich countries. Changes in rainfall patterns, in particular, can be catastrophic for millions of people. Further, with a growing population in many countries, the supply of fresh water is critical to existence. So we must give attention to how water can be collected, how it can be conserved, and how it can be protected against pollution. Where does moringa come in? First, moringa is a good source of nutrition that is very drought resistant. Secondly, where water is dirty, crushed moringa seeds act as a natural coagulant and water purifier.

Visitor: Who discovered that?

H-M H: In my opinion, it was Moses. In Exodus 17:3-4 the people suffered thirst so badly that Moses feared he would be stoned. The children of Israel wished they were back in Egypt, where at least there was fresh water! Then Moses found water, but it was bitter. What could he do? In chapter 15: 25, “Then Moses cried out to the LORD, and the LORD showed him a piece of wood. He threw it into the water, and the water became fit to drink” This could well have been the moringa tree! Today the Tropics are knee deep in PET bottles, towns suffer flooding because the drains are blocked with these bottles, piles of bottles and other rubbish destroy nature and people become dependent on private water suppliers, instead of becoming free and, with the help of the moringa tree, producing their own drinking water.

Visitor: Thank you. I think moringa is more than a “miracle tree” – it is a real life-saver.

2. *Moringa oleifera*: Recognition



Moringa Seeds are brown and have white wings in three directions. These wings look like paper.



This is the shape of Moringa Leaves.



The seed-pods

Inside the seed-pod are between 10 and 30 seeds, like the one illustrated.

The seed pods grow from the white flowers. At first they are green and thin like a pencil. Later they grow bigger, as long as a ruler and as thick as a thumb. After some weeks they become dry and brown. They are then very light.

When the pods are young, either the pods or the young seeds may be cooked and eaten in a variety of ways, see Chapter 6.

Uses for the flowers

After about 8 months to a year, the tree begins to flower and continues year round. The flowers can be eaten, usually by frying them either alone or in batter. They can be used to make a refreshing tea by pouring boiling water over the leaves and allowing them to steep for 5 minutes. In Haiti tea from the flowers is drunk for colds. The flowers provide good amounts of both calcium and potassium. They may be added to any moringa leaf recipes.

Moringa flowers are also good for beekeepers since they provide a year-round source of nectar.

Uses for the roots

Small trees a few months old can be pulled and the taproot ground, mixed with vinegar and salt and used in place of horseradish. When grown for its roots, the seeds are sometimes planted in a row like vegetables. At about 60 cm in height the tree is harvested.

Caution: When using moringa roots, always scrape off the root bark. Root bark contains alkaloids which may have unpleasant effects. Even the root itself should be eaten in small quantities.

Moringa stenopetala

This tree is similar to *Moringa oleifera* in almost every respect, except that it is a bigger tree and the leaflets are substantially bigger (and therefore easier to harvest). The seeds, however, look quite different; they are white in colour.

3. Moringa: Propagation and cultivation

We recommend that every home, every school and every health centre and hospital should grow and use moringa trees.

Moringa trees may be grown

- as a hedge around a garden,
- as hedges within a vegetable and / or medicinal garden.
- Intensively in a small plot.

The majority of the moringa trees should be grown for their leaves, and a few trees should be mainly kept for their pods and seeds. The trees grown for leaves should be regularly trimmed.

Both *M. Oleifera* and *M. Stenopetala* grow on very poor and even salty ground - a real wonder!

Hedges act as a windbreak, provide some shade, and increase the fertility of the soil. If the garden is on a slope, and the hedges are planted along the contour lines, then such hedges also prevent soil erosion and loss of soil nutrients.

In such hedges, moringa may be mixed with other plants and trees, e.g. vetiver grass, lemon grass, leucena, *Cassia spectabilis*, *Jatropha curcas*. Vetiver grass has deep roots and binds the soil effectively against soil erosion on steep slopes.

Such a mixed hedge has several advantages; each plant has a particular benefit, e.g. lemon grass yields tea which is good for the health, some plants increase soil fertility and a variety of plants serves to protect each other from disease.

Moringa is enjoyed by livestock. If roaming animals are a problem, protect your garden with a thick hedge. On the outside plant such as *Jatropha curcas* or *Acacia laeta*, which goats do not eat, and on the inside plant a row of moringa trees.

Moringa may be grown from seeds or cuttings.

Growing from seed – germinating on the surface of the soil

Screw up a piece of newspaper into a ball, put about 5 moringa seeds into it and keep the newspaper moist, in the shade, for several days. Fill a plant pot (plastic, ceramic or banana leaf) with river sand and place those seeds that have germinated just half in the sand with the new root well buried. Keep the soil damp but not wet. Now transplant the seedling into a pot with good soil. Leave in the shade until green leaves appear, when it can be placed in the sun.

We have developed this method because moringa seeds contain a lot of protein, and are often destroyed by microbes if planted directly in wet soil.

Growing from seed – germinating in pots

1. Fill small containers (made from banana leaf, plastic or ceramic) with a light soil mixture, i.e. 1 part of humus rich soil to 1 part of sand.
2. Plant two or three seeds in each container, half a centimetre deep.
3. Keep moist but not too wet. Germination will occur within two weeks.
4. Remove extra seedlings, leaving one in each container.

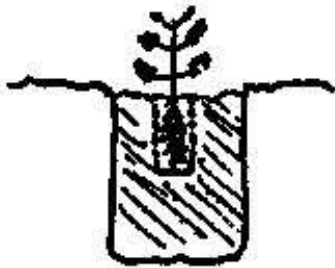
Transplanting

Transplant the seedlings after about four months when they are about 60 cm high.

The ground where the trees are to be planted should be light and sandy, not heavy with clay or water-logged.

1. Dig a round hole 50 cm across and 60 cm deep. Backfill with loose soil. Adding compost or manure will help the trees grow better.
2. Water the planting holes one day before transplanting the seedlings.





3. Plant seedlings in the late afternoon to avoid the hot sun the first day.
4. Make a hole in the pit to accept all soil around the moringa roots. Be careful to keep the soil around the seedling's roots intact.
5. Pack the soil around the seedling.
6. Keep the soil moist but not too wet.

If the seedlings fall over, tie them to a stick for support. Protect young saplings from termites and nematodes.

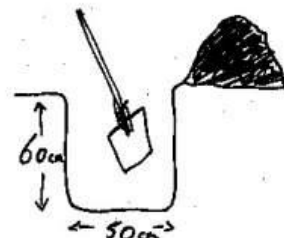
Growing from seed – sowing directly into the ground

To plant seeds directly in the ground:

1. Choose an area with light, sandy soil.
2. Dig holes 50 cm across and 60 cm deep. Back-fill the holes with loose soil. Compost or manure will help the tree grow better, even though moringa trees can grow in poor soils.
3. Water the hole the evening before planting, or wait for a good rainfall.



4. Plant 3 to 5 seeds in each hole, 5 cm apart. Plant the seeds no deeper than three times the width of the seed (approximately 1 to 1.5 cm, the size of one's thumbnail).
5. Keep the soil moist enough so that the top soil does not dry out and choke the emerging seedlings, but also not too wet or the seeds may rot and die.



6. When the saplings are 10 to 15 cm tall, keep the healthiest sapling in the ground and remove the rest. Termites and nematodes can kill a young sapling. Take measures to protect saplings from these two dangers (e.g. by mixing some neem leaves into the soil before planting).

Note: If the soil is heavy, dig a larger hole of up to 90 cm in diameter and 90 cm deep, and backfill with 1 part sand and 2 parts original soil. Adding compost or manure will help.

Growing from cuttings

1. Make a cutting at least 2.5cm in diameter and at least 1.8m long.
2. Dig a hole 1m across and 1m deep.
3. Place the cutting in this hole and fill with a mixture of soil, sand and composted manure. Pack the soil firmly around the base of the cutting. On the surface, form a slight dome or cone shape, sloping down away from the cutting, to keep water away from the stem of the new tree.
4. Water generously, but do not water so much that the soil becomes waterlogged.

In India, the custom is to put some cow dung on top of the open end of the cutting. This is an excellent way to protect the cutting from pests.

Maintenance of Moringa trees

The majority of the moringa trees are used for their leaves. In general, the more moringa trees are cut back, the more leaves they produce.

Either

- a) When the trees are about 60 cm high, cut the central growing stem 10 cm from the top. This encourages the plant to grow more branches. About one month later, when the branches have reached a length of 20 cm, cut them by 10 cm. Again, after another month has passed, cut the new branches in the same manner. This pruning causes the trees to become bushy and remain small, making harvesting of the leaves and pods (and therefore the seeds) much easier, or
- b) Whenever the trees reach a height of about 1 metre, harvest the leaves by pruning the trees down to 30 cm. Strip the stems of their leaves, which are dried and used to make moringa leaf powder (see below). The stems can be fed to livestock, or composted.

Tips for a good harvest; including pest control

(These notes are taken from the excellent new book “Growing and processing moringa leaves” published by Moringa News. See the Bibliography.)

1. Avoid planting moringa where the ground has been used to dump household or industrial waste, where the ground is water logged, where the soil is infested with termites and where animals roam freely.
2. Grow moringa with other crops, space the moringa trees 2 to 4 metres apart and plant the rows east-west so that all plants receive sunlight. Avoid crops that require a lot of nitrogen such as maize or cassava, plants that need chemical treatments and crops that may compete for light such as millet or sorghum. It is better to mix moringa with crops that enrich the soil with minerals or nitrogen, such as groundnuts, soya or beans.
3. Moringa can germinate and grow without irrigation if it is sown during the rainy season. Its tuberous root develops in twenty days and allows young plants to endure drought. However, for optimal growth, it is advisable to irrigate regularly during the first 3 months after seeding.
4. Fungal diseases are by far the most serious in moringa farming. Brown spots can appear on the leaves and then spread to cover them entirely, turning the leaves yellow and killing them. The area around the trees, in organic farming, should be kept clear of weeds which are often hosts to diseases. The leaves and young shoots should be checked regularly for symptoms of fungal attacks. An early detection will save a lot of young plants from destruction. Neem leaf or seed extract can be sprayed on the plants to control pest and fungal attacks. The neem extract should be used as early as possible and sprayed repeatedly. Neem products can be produced locally and are not toxic for humans.
5. The most common pests are grasshoppers, crickets and caterpillars. These insects bite and chew parts of the plant, causing the destruction of leaves, buds, flowers, shoots, fruits or seeds as well as the interruption of sap flow. These outbreaks are frequent in dry zones where moringa leaves strongly attract insects. It seems that these outbreaks occur at the beginning of the dry season when insects cannot find other tender, green material to feed on. The best solution, in this case, is to cut back the trees, leaving no green part apparent. The following growth is very vigorous if conditions permit (sufficient water supply).
6. In organic farming, *Bacillus thuringiensis* is an insecticide composed of bacteria specific to Lepidoptera larvae. It must be ingested to be activated, with no impact on humans, wildlife or pollinators. The waiting period before harvesting is only three days. This insecticide is a good alternative to chemical products, is authorised in organic farming and has the advantage of being a guaranteed preparation. These products should be stored, if possible, in a cool place, at least protected from strong heat. Neem extract can also be used against insects, if it is sprayed in time.
7. Termite attacks also cause damage to moringa plantations. Some organic solutions exist for termite control:
 - Applying neem seed cakes to the soil.
 - Applying castor oil plant leaves, mahogany chips, tephrosia leaves or Persian lilac leaves around the base of the trunk.
 - Heaping ashes at the base of the trunk.

Building termite traps using bowls filled with wet straw, soil and other vegetable waste (wood chips, mango pits). The bowls are filled in the morning, turned upside down against the soil, the edges slightly buried and covered with a handful of dry leaves to maintain coolness. These traps should be checked every 24 to 48 hours.

4. Moringa Seed Oil

When the seeds are still immature, they can be cooked like peas or fried.

The mature seed is about 40% oil. Moringa oil is of excellent quality for cooking. It is as nutritious as olive oil, containing 73% oleic acid, which is very similar to olive oil. It is very slow to turn rancid, and is excellent in salads. Sold sometimes as "ben oil", it is not only used in cooking but also for perfumes and for lubricating delicate mechanisms such as watches. It is used as a substitute for sperm oil which is used in industry. It is also used for making soap and in lamps.

How to extract moringa oil from seeds

The seeds are best used when fully mature but still fresh and undamaged.

A) Manually

1. From "**Trees for Life**": www.treesforlife.org/moringa/uses_vegoil.htm

1. Brown the seeds in a skillet.
2. Mash the seeds thoroughly.
3. Place the seed mash in boiling water.
4. The oil will rise to the surface, where you can skim it off.

2. From **ECHO**: <http://www.echonet.org/Technotes/Moringa.html>

The seeds from mature pods are roasted, mashed and placed in boiling water for five minutes. After straining and sitting overnight, the moringa oil floats to the surface.

B) Using a screw press

1. From **ECHO**:

http://www.echonet.org/tropicalag/knowledgebank/EDN_articles/edn_68_1.htm

Nikolaus Foidl designed a motorized moringa seed de-huller with a built-in blower to separate out the chaff. The de-hulling part of the machine consists of two revolving rubber plates slightly oval in shape. Seed is run through 3 times, with the space between the plates diminished slightly each time (smaller seed not de-hulled the first time will be de-hulled the 2nd or 3rd time).

Nikolaus suggests that a screw press made of simple iron may be better suited to moringa oil extraction than one made of steel. Chromium and nickel in the steel may react with the oil and lower oil quality.

Following extraction, moringa oil should be filtered (through cheese cloth or coffee filter). This will remove the protein content upon which bacteria feed. Viscosity of oil can be improved by heating it to 40-50° C before filtering.

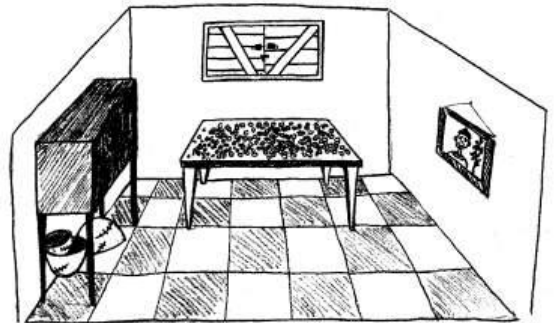
2. From **Footsteps magazine (Issue 28)**:

"Moringa seed has a fairly soft kernel, so the oil can be extracted by hand using a screw press (also known as a "spindle" or "bridge" press). The seed is first crushed, 10% by volume of water is added, followed by gentle heating over a low fire for 10-15 minutes, taking care not to burn the seed. One such test yielded 2.6 litres of oil from 11 kg of kernels. Once the best processing conditions are worked out, an extraction efficiency of 65% could probably be expected."

The seed cake left over after extracting oil can be used for water purification, or as fertilizer.

5. To make moringa leaf powder

1. **Pay close attention to hygiene.** You and the people who help you to harvest the leaves must always wash your hands with soap and under running water before eating and after using the toilet. None of you must have any skin or infectious diseases. You must be wearing clean clothes and not wearing any jewellery or ornaments. The moringa trees should be well away from any industrial area, from fields on which agricultural chemicals have been used and from the street.
2. Harvest the leaves. As already stated, we recommend that you harvest the plants when they are about 1 metre high, leaving stumps that are 30cm high. These stumps produce new shoots, which provide another harvest about two months later.
3. Bring the harvest directly to the house. The best way is to carry them in baskets, and keep them away from dust. Keep the leaves out of direct sunlight to avoid the loss of vitamins.
4. Dip the harvested, small branches in salt water and then fresh water to ensure they are absolutely clean.
5. Then either
 - a) hang the branches from a string with a clean cloth underneath to collect the dry leaves as they fall. After one or two days the branches can be beaten on the cloth and the remaining leaves will fall off, or
 - b) spread the leaves out thinly on a clean cloth to dry, out of the sun and wind, and preferably indoors, e.g. on a table, or
 - c) strip the leaves from the stems and dry in a solar drier. If the atmosphere is very humid, then is really the only effective way to dry the leaves. If even this fails, then use a solar oven. Control the temperature so that it does not rise above 50°C. Unfortunately, by drying in the direct sunlight, most of the vitamins will be destroyed.



Chop the twigs and stems into pieces of 10 cm or less and feed them to cattle, sheep and goats.

6. The leaves should dry in three days or less. It is very important that they are dried very thoroughly. To test whether they are really dry, if you have no hygrometer, bend a leaf stem through 90 degrees; when thoroughly dry the stem will break with a crisp snap. In this case, to be safe, the leaves should be stored for no more than one year. If the stem does not crack audibly, then dry more in a solar oven (see above).
7. A much better test is to put at least two handfuls of dried leaves into a sealed container and lay a small hygrometer (obtainable from anamed) on the surface. After one hour read the hygrometer. If it registers 40% or less, the leaves may be kept for up to three years, if 50% one year, and if 60% 3 months. If it reads more than 60% the moringa must be dried more, because of the risk of mould developing.
8. Pound the dried leaves to a powder with a clean mortar and pestle.
9. Rub the leaf powder through a sieve to remove any remaining stalks.
10. Store the leaf powder in an air-tight, dark container. The powder must be protected from humidity (e.g. in the rainy season in the Tropics) and from sunlight.

Prepare enough leaf powder when the trees are growing vigorously so that you have a plentiful supply. In times of drought moringa trees lose their leaves. It is usually considered that 8 kg of fresh leaves, without stems, are required to produce 1 kg of leaf powder.

Suggested Dosage:

For children: one heaped teaspoonful one to three times a day. Adults, including pregnant or nursing women, may take rather more but should carefully monitor the effects on their body size, blood pressure (especially if they suffer low blood pressure) and, if diabetic, blood sugar levels.

6. Moringa for Nutrition

In many *anamed* seminars we show the video “*Moringa oleifera*: Natural Nutrition for the Tropics” (available from ECHO). In this video several people who participated in this project in Senegal give an account of the ways in which they benefited, for example their malnourished babies were healed, pregnant mothers were much more healthy, and not only did their babies have higher birth weights but various health complaints disappeared, e.g. skin problems, and a diabetic describes how his sugar levels were stabilised.

Our seminar participants have now planted many moringa trees in many countries. Christine Candiru was a primary health care worker in the extreme north west of Uganda, attached to Kei Health Centre. As a result of her work she reported that most people in the villages she visited had a moringa tree in their garden, and malnourishment became a thing of the past. Many under-nourished mothers complained of having insufficient breast milk – until they included moringa in their diet.

Washed moringa leaves may be eaten fresh. They may be added to any salad. They may also be cooked like spinach. In southern Ethiopia, many families have a *Moringa stenopetala* tree in their garden. Once a week, or sometimes more often, they cook moringa leaves like they cook cabbage, as a vegetable. In fact, in Ethiopia, to have such trees in the garden gives them status in the community. The leaves of *Moringa stenopetala* are easier to harvest and cook than those of *Moringa oleifera* simply because they are bigger, but the leaves of both are very nutritious. Some say that *M. oleifera* leaves taste better. The leaves of *M. stenopetala* should not be eaten every day because, in areas of high incidence of endemic goitre, there is the risk that this problem might be made worse.

One rounded tablespoonful of moringa leaf powder contain 272% of the vitamin A requirement of a small child, 42 % of the protein, 125% of the calcium, 71% of the iron and 22% of the vitamin C. (See “The Miracle Tree” page 114).

Much of the information in this chapter is taken from “Trees for Life”, www.treesforlife.org/our-work/our-initiatives/moringa

Gram for gram, fresh Moringa leaves contain:

- 7 times the vitamin C of oranges
- 4 times the calcium of milk
- 3 times the potassium of bananas
- 2 times the protein of yogurt
- 4 times the vitamin A of carrots
- $\frac{3}{4}$ the iron of spinach

Gram for gram, Moringa leaf powder contains

- $\frac{1}{2}$ the vitamin C of oranges
- 17 times the calcium of milk
- 15 times the potassium of bananas
- 9 times the protein of yogurt
- 25 times the vitamin A of carrots

Thus Moringa leaves contain a wealth of essential, disease-preventing nutrients. They even contain all of the essential amino acids, which is unusual for a plant source.

Since the dried leaves are concentrated, they contain higher amounts of many of these nutrients, except vitamin C.

The nutritional content of organic matter can vary depending on the variety, seasons, climate, and soil conditions. Thus, different analyses produce different figures. For example, some studies show the potassium content of Moringa leaves as lower and iron content as higher than what is shown here.

The analysis for fresh Moringa leaves comes from Gopalan, et al., based mostly on analysis done at the National Institute of Nutrition in Hyderabad, India. (1)

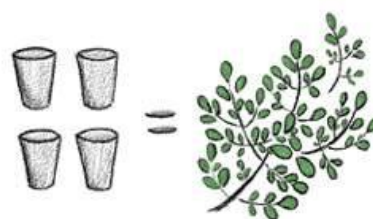
The analyses of dried Moringa leaves comes from Fuglie, carried out at the University of Leicester in England. (2)

Vitamin A is obtained from vegetables in the form of its precursor, carotene. The intestines only absorb a fraction of the carotene in foods. There are differing views on how to calculate the amount of carotene that is absorbed and converted to vitamin A. For vitamin A content, Gopalan et al. and Fuglie simply give the figures for carotene or beta-carotene. The most commonly accepted ratio of carotene to vitamin A (retinol) is 6:1.

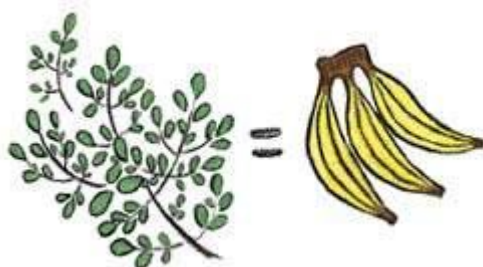
**The Miracle of Moringa Leaves: It's like growing multi-vitamins on your doorstep.
Gram for gram, fresh moringa leaves contain:**



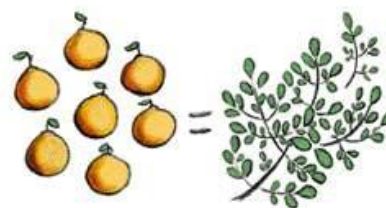
4 times as much vitamin A as carrots. Vitamin A is a shield against eye disease, skin disease, heart ailments, diarrhoea, and many other diseases.



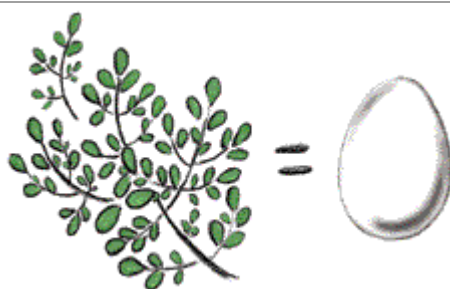
4 times as much calcium as milk. Calcium builds strong bones and teeth, and helps prevent osteoporosis for strong bones and teeth.



3 times as much potassium as bananas. Potassium is essential for the functioning of the brain and nerves for healthy brain and nerves.



7 times as much vitamin C as oranges. Vitamin C fights a host of illnesses including colds and flu



Nearly equal protein to eggs. Proteins are basic building blocks of all our body cells.

Amino Acid Content of Moringa Leaves*

	Fresh Leaves	Dried Leaves (moringa leaf powder)
Arginine	406.6 mg	1,325 mg
Histidine	149.8 mg	613 mg
Isoleucine	299.6 mg	825 mg
Leucine	492.2 mg	1,950 mg
Lysine	342.4 mg	1,325 mg
Methionine	117.7 mg	350 mg
Phenylalanine	310.3 mg	1,388 mg
Threonine	117.7 mg	1,188 mg
Tryptophan	107 mg	425 mg
Valine	374.5 mg	1,063 mg

All values are per 100 grams of edible portion.

*While Gopalan, et al. expressed amino acid content per g N (nitrogen), these figures have been converted to mg per 100g leaves for clarity.

Vitamin Content of Moringa Leaves All values are per 100 grams of edible portion.

	Fresh Leaves	Dried Leaves (moringa leaf powder)
Vitamin A - β carotene	6.78 mg	18.9 mg
Vitamin B1 - thiamin	0.06 mg	2.64 mg
Vitamin B2 - riboflavin	0.05 mg	20.5 mg
Vitamin B3 - niacin	0.8 mg	8.2 mg
Vitamin C - ascorbic acid	220 mg	17.3 mg

Vitamin A deficiency is a killer. It is a leading cause of childhood death in developing countries. Normally, vitamin A acts as a shield against disease. But malnourished people who lack this vitamin are left defenceless. They easily fall victim to a host of common illnesses, including measles, and also to cataracts, and diseases of the skin and eyes. According to the World Health Organisation, an estimated 250,000 to 500,000 vitamin A-deficient children become blind every year, half of them dying within 12 months of losing their sight. (3)

Mineral Content of Moringa Leaves All values are per 100 grams of edible portion.

	Fresh Leaves	Dried Leaves (moringa leaf powder)
Calcium	440 mg	2,003 mg
Copper	0.07 mg	0.57 mg
Iron	0.85 mg	28.2 mg
Magnesium	42 mg	368 mg
Phosphorus	70 mg	204 mg
Potassium	259 mg	1,324 mg
Zinc	0.16 mg	3.29 mg

Nutritional Content of Moringa Leaves All values are per 100 grams of edible portion.

	Fresh Leaves	Dried Leaves (moringa leaf powder)
Calories	92 cal	205
Protein	6.70 g	27.1 g
Fat	1.70 g	2.30 g
Carbohydrate	12.5 g	38.2 g
Fiber	0.90 g	19.2 g

An anamed recipe for children

Ingredients

1 heaped teaspoonful of maize flour

½ glass (100ml) water

2 teaspoonfuls of red palm oil (4g) or any locally available good quality oil, or 1 teaspoon of butter (5g).

1 heaped tablespoon of moringa leaf powder (12g)

For undernourished children only, 2 teaspoonfuls of honey or 1 heaped teaspoonful of sugar.

The flesh of half a ripe avocado or 1 teaspoonful of peanut butter.

Preparation: Bring the maize flour and water together to the boil whilst stirring continuously, and allow to stand in a warm place for ten minutes to rise. Then stir in the other ingredients.

A Recipe for Moringa leaf powder stew

Ingredients

200 grams (1/4 cup) peanut butter
1 litre water
500 grams of meat, cut into small pieces
25 grams (3 tablespoons) of Moringa leaf powder
1 medium-size onion, finely chopped
2 cloves garlic, finely chopped
Salt, pepper and chilli powder.

Preparation: Put the water and meat into a pot and bring to the boil. Cover the pot and boil until the meat is soft, and then add the peanut butter, onion, garlic and spices. Bring to the boil again, remove from the heat and add the Moringa leaf powder. Serve over rice or millet couscous.



Moringa pods as a vegetable

1. When the pods are young and thin, cut them into pieces and cook like beans.
2. When the pods are almost as thick as a finger, but still green and tender, cut into finger sized pieces and boil in water with salt for about 15 minutes. Then cut the pieces open and scrape out the white flesh (if still soft) and the seeds. Eat immediately, or dry for later use.
3. When the pods are slightly older and the flesh is hard, open the whole pod by twisting it. The “peas” can be scraped out, washed in clean water and fried in oil. Alternatively they can be cooked like peas, fresh or dried.



In India, Moringa pods are widely consumed. Moringa is grown on a large scale to produce pods for export, both fresh and in tins.

Use of the flowers

The trees begin to flower 8 to 12 months after sowing, and continue to flower throughout the year – and so they are very popular with bee-keepers. Flowers may be eaten, either as they are, or fried (they taste like mushrooms) or fried in pancake mixture. They can be taken as a refreshing tea simply by pouring boiling water over the flowers and allowing the tea to brew for 5 minutes. In Haiti this tea is drunk for the common cold. They can be added to every recipe for moringa leaf powder. The flowers contain a lot of calcium and potassium. **Caution:** We are advised that eating flowers may prevent conception, and if used during pregnancy, they may cause abortion.

Use of the roots: Small trees which are just a few months old may be uprooted and the roots grated and mixed with vinegar and salt and used as horseradish. To grow moringa trees for their roots, plant the trees in a row like vegetables, and harvest when the trees are 60cm high. **Caution:** When using the roots always remove the root bark, as they contain two alkaloids and moringin, which is toxic. Do not eat moringa roots to excess, and pregnant women should not eat them at all.

References

1. Gopalan, C., B.V. Rama Sastri, and S.C. Balasubramanian. Nutritive value of Indian foods. Hyderabad, India: (National Institute of Nutrition), 1971 (revised and updated by B.S. Narasinga Rao, Y.G. Deosthale, and K.C. Pant, 1989).
2. Fuglie, Lowell J., ed. The Miracle Tree: Moringa oleifera: Natural Nutrition for the Tropics. Training Manual. 2001. Church World Service, Dakar, Senegal. www.moringatrees.org/moringa/miracletree.html, May 2002.
3. www.who.int/nutrition/topics/vad/en/

7. Moringa in anamed medicine: Experiences

Participants in anamed seminars are always impressed by moringa. Many people have good stories, for example, a nurse in Ethiopia said that people who eat moringa suffer many fewer eye problems, diabetic patients report that their blood sugar levels have stabilized, and many AIDS patients report having been helped enormously to return to health and strength with moringa. We have received similar feedback from many people in many countries.

For most of the following health problems, take moringa;

- by cooking fresh leaves as a vegetable, as you would prepare spinach, or
- by preparing moringa leaf powder and adding it to your food, or
- by drinking tea made of fresh or dried leaves. Pour 1 litre of boiling water over 5 grams of leaf powder (a heaped teaspoonful) or 40 grams of fresh leaves.

A. MALNUTRITION: The proverb “Let your food be your medicine and your medicine your food” applies very much for moringa. Most people who regularly consume moringa leaves, whether as a vegetable prepared from fresh leaves, or moringa leaf powder in sauces or mixed in other dishes, or as tea, claim to keep amazingly fit and well.

In the United States moringa is now big business, being sold as a health drink under the name of Zija. According to their web-site, “*Dozens of humanitarian organizations now promote the use of Moringa in poverty-stricken areas to combat malnutrition and its adverse effects on the body. Groups such as Church World Service, Educational Concerns for Hunger Organization, National Science Foundation, and others are reintroducing the different health benefits of this fast-growing, drought-resistant plant to malnourished people in various underdeveloped areas. While conventional treatments for malnutrition normally take months, healthcare professionals have discovered that people taking Moringa show improvement within days. One of the more amazing things Moringa is being used for is to prevent childhood blindness, a condition that can develop from vitamin A and retinol deficiencies. Moringa contains sufficient amounts of these nutrients to eliminate this condition.*”¹.

After seeing the film “*Moringa oleifera: Natural Nutrition for the Tropics*” during an anamed seminar a primary health care nurse introduced moringa in the villages in the extreme north-west of Uganda where she worked, with the result that families planted moringa trees in their gardens, and the number of children suffering malnutrition reduced dramatically.

B. AIDS Experience in Musoma, Tanzania, and several other anamed health projects has shown that the following treatment showed a remarkable effect with AIDS patients. Many people have regained their energy and once again lead an active life. Even people who were unable to get out of their beds and were hardly able to walk have experienced a dramatic improvement in their CD4 count and today are strong enough to work in their house, business and garden. A few of them even work now as anamed trainers and not only help others who are HIV positive but also other patients with their illnesses.

HIV positive people in the Tropics emphasise that “A-3 Tea” (from home grown *Artemisia annua anamed*) is very effective in limiting the multiplication of the virus and in boosting the immune system. By adding moringa to each meal the body also develops health and strength. Moringa and artemisia belong together! We have received feedback from many health centres which now use this combination therapy.



This young Kenyan lady Sarah lost her husband to AIDS, and she herself was very ill. However with love from her mother-in-law, artemisia tea and moringa leaf powder, she is now strong and active, and in fact runs a self-help group for others infected with HIV.

¹ See http://zjapower.com/?page_id=184
anamed Moringa Reader

In detail:

- *Moringa oleifera*: Prepare leaf powder from *Moringa oleifera* and add a heaped teaspoonful 3 times daily to your meals.
- *Artemisia annua anamed*: Drink *Artemisia annua anamed* tea. During the first month, and longer if the symptoms are still acute, drink 1 litre of artemisia tea every day. To make the tea, pour one litre of boiling water over 5 grams of dried leaves and allow the tea to stand for at least 15 minutes. Later when the acute symptoms have disappeared, continue to drink 1 cup (250 ml) of artemisia tea daily.

For further information on AIDS and the treatment of opportunistic infections, see our publication No. 115, "AIDS and Natural Medicine".

C. DIABETES (Diabetes mellitus type 2) in the Tropics: Several patients have reported that their blood sugar levels were reduced by regularly eating moringa leaf powder. Depending on the severity they took between one and three heaped teaspoonfuls per day. Some patients found it more effective to chew and swallow one white seed kernel of *Moringa oleifera* 3 times a day, or to drink moringa tea. Do have your blood sugar levels checked regularly! Moringa also has the effect of reducing blood pressure, so it is important also to monitor your blood pressure.

D. TUMOURS According to our anamed doctor, Dr Heiner Kuhn, even very frail cancer patients in Germany are thankful for moringa leaf powder; their bodies become stronger and they gain sufficient self-confidence to leave their beds and slowly to become active again. For the treatment of tumours and to prevent metastasis anamed also recommends the use of artemisia tea (made of *Artemisia annua anamed* leaves). The constituent artemisinin has already been clinically researched and is used today in the treatment of cancer. The recommended treatment is as for AIDS above.

E. HIGH BLOOD PRESSURE Take one heaped teaspoonful of moringa leaf powder 3 times daily, and check whether this results in a reduction in your blood pressure. This may not always be effective, because high blood pressure has many different causes.

F. For ANAEMIA and for more breast milk: Eat moringa leaves as a vegetable or as dried leaf powder.

G. OTHER TREATMENTS:

As a gentle, **natural antibiotic**. Moringa contains pterygospermin, which kills bacteria and fungi. The regular consumption of moringa can fend off infections caused by bacteria and fungi.

Skin treatment. For the preparation of medicinal oils or skin ointments either moringa leaf powder or crushed seeds may be used.

As an **anti-inflammatory** take moringa tea or add moringa leaf powder to your food.

For **stomach ulcers** take moringa tea or add moringa leaf powder to your food.

Moringa tea **relaxes the muscles** and helps one to sleep

Other observations and recommendations regarding moringa for nutrition

So far no negative side effects have been observed, even when *Moringa oleifera* is eaten daily. *Moringa oleifera* may be eaten as a vegetable every day; but *Moringa stenopetala* only 2-3 times a week.

"... The presence of a small amount of cyanogenic glucosides in *M. stenopetala* leaves may have a health risk in areas of high incidence of endemic goitre as an exacerbating factor if consumed for a long period of time." *M. Stenopetala* leaves contain 79–89 mg cyanogenic glucosides per 100 g leaves.²

Of course, your diet should not only be based on moringa!

We recommend that moringa roots be use internally only in very small amounts. "Horseradish" is not a part of the diet in the Tropics!

Roots may, however, be used externally, e.g. as an ointment.

² Abuye et al. (2003) East African Medical Journal 80(5): 247-252

8. Moringa in the anamed pharmacy: Suggestions for the preparation of medicines

Suggestion 1: **Wound dressing solution**

Collect moringa flowers (oleifera or stenopetala), clean, put 1-2 handfuls in 1 litre of water, add 1 tablespoonful of cooking salt (this equals 9 grams), cover and boil for 5 minutes, sieve through a sterile cloth or coffee filter and allow to cool down. Wash infected wounds and burns. Always prepare freshly.

Suggestion 2: **Ointment for skin care and haemorrhoids**

Put 25 to 50 g of moringa leaf powder (oleifera or stenopetala) in 1 litre of vegetable oil, heat on a water bath for 1 hour, sieve through a clean cloth, add 100 g of melted beeswax and pour into small ointment containers. Keeps for 1 year. For skin care, massage into WET SKIN.

Suggestion 3: **Ointment for eczema and skin infections**

Put 50 to 100 g of moringa leaf powder (oleifera or stenopetala) in 1 litre of vegetable oil, heat on a water bath for 1 hour, sieve through a clean cloth, add 100 g of melted beeswax and pour into small ointment containers. Keeps for 1 year.

Suggestion 4: **Ointment for wounds**

Clean moringa roots (oleifera or stenopetala), crush or cut into small pieces, dry and pound. Put 100 g in 1 litre of vegetable oil, add 100 g of beeswax, put this directly on the fire without a water bath for 15 minutes at 95 degrees and stir constantly (with a thermometer). Sieve immediately through a clean cloth and pour into new ointment containers. Keeps for 1 year.

Suggestion 5: **Diabetes powder** (oleifera)

4 g per dose. Three times daily take 4 g of moringa leaf powder with food. This corresponds to taking a heaped teaspoonful three times per day together with a cup of water. Alternatively, after meals drink a cup of moringa tea, made by pouring boiling water over a heaped teaspoonful of moringa leaf powder.

Suggestion 6: **Powder for hypertension (high blood pressure)** (oleifera)

4 g per dose. Three times daily take 4 g of dried leaves as powder; i.e. take a heaped teaspoonful 3 times daily together with a cup of water or home-made fruit yoghurt. Alternatively, after meals drink a cup of moringa tea, made by pouring boiling water over a heaped teaspoonful of moringa leaf powder. In addition, 3 times a day eat up to 10 g of fresh garlic, just as much as is good for you and your stomach.

Suggestion 7: **Gastritis powder** (oleifera)

4 g per dose. 3 times daily take 4 g of moringa leaf powder. In regions with inadequate medical provision almost the entire population is infected with the pathogen *Helicobacter pylori*. This bacterium is transferred through faecal contaminated water. It causes chronic low-level inflammation of the stomach, which in turn can cause gastritis, gastric ulcers and, according to WHO, possibly gastric cancer. The isothiocyanates in Moringa are exceptionally active in combating this bacterium³. In addition, 3 times a day eat up to 10 g of fresh garlic, just as much as it is good for you and your stomach.

Suggestion 8: As an experimental treatment with tumours. Laboratory tests have shown some constituents of Moringa to be active in destroying cancer cells (referred to as apoptosis) in tumours of the ovaries, lungs, breast, skin, gullet and pancreas⁴. Whether this also works in vivo, i.e. with humans, remains to be confirmed by further research, which no organisation is willing to finance! So the only possibility is to try it out oneself! Our anamed doctor in Tanzania, Dr. Peter Feleshi, has had some success in treating cancer patients with *Moringa oleifera* leaf powder and *Artemisia annua anamed* powder taken either as powder or as tea. Suggestion: morning and evening, at each mealtime, into a cup put three heaped teaspoonfuls of artemisia powder (5g) together with a heaped teaspoonful of moringa powder (5g), mixed with 2 tablespoonfuls of natural yoghurt and half a spoonful of jam. Mix and eat. Drink a lot, as both artemisia and moringa are very diuretic. If possible work together with a doctor and have your tumour markers checked regularly. In addition, if your stomach allows 3 times a day eat up to 10 g of fresh garlic.

³ <http://internationalresearch.webnode.com/news/moringa-disease-treatment-and-prevention/>

⁴ See for example www.moringasource.com/moringa-and-cancer.php/.

9. Use of Moringa in agriculture and with livestock

Most of the information in this chapter is based on research conducted in Nicaragua by by Nikolaus and Gabriele Foidl of BIOMASA. BIOMASA is an agricultural research program located in Nicaragua that has studied various aspects of moringa for many years.

Source: “New Uses of Moringa Studied in Nicaragua”, written by Lowell Fuglie and first appeared In: ECHO Development Notes, Issue 68. <http://www.echocommunity.org/resource/collection/CAFC0D87-129B-4DDA-B363-9B9733AAB8F1/edn68.pdf>

Moringa leaf extract as a plant growth hormone

Juice from fresh moringa leaves can be used to produce an effective plant growth hormone, increasing yields by 25-30% for nearly any crop: e.g. onions, bell pepper, soya, maize, sorghum, coffee, tea, chilli, melon. One of the active substances is Zeatin: a plant hormone from the Cytokinines group. This foliar spray should be used in addition to (and not instead of) other fertilizers and watering etc.

In one trial, use of this spray increased maize yields from 60 to 130 sacks per hectare. Using this hormone, BIOMASA was able to grow coffee at 30 meters altitude. Coffee, shaded with *Jatropha curcas*, produced beans in just 17 months.

To make the spray:

- a) Make an extract by grinding young moringa shoots (not more than 40 days old) together with a little water (about one litre per 10 kg fresh material).
- b) Filter the solid out of the solution. This can be done by placing the solution in a cloth and wringing out the liquid. The solid matter, which will contain 12-14% protein, can be used as livestock feed.
- c) Dilute the extract with water at a 1:32 ratio and spray directly onto plants (if the extract is not going to be used within five hours, it is best stored in a freezer until needed). Apply about 25 ml per plant.



The foliar spray should be applied 10 days after the first shoots emerge from the soil, again about 30 days before plants begin to flower, again when seed appears and finally once more during the maturation phase.

Moringa Shoots as Green Manure

Using moringa as a green manure can significantly enrich agricultural land. In this process, the land is first tilled. Moringa seed is then planted 1-2 cm deep at a spacing of 10x10 cm (a density of one million seed per hectare). The density can be greater. The only limits to plant density are availability of seed, water and fertilizer. After 25 days, the seedlings are ploughed into the soil to a depth of 15 cm.

Seeding can be done mechanically if the seed is first de-hulled. Planting kernels will reduce germination time by up to three days.

A simple method of seeding is to first rototill the soil to a depth of 10 cm, then scatter seed over the soil and rototill again to a depth of 2-3 cm.

Intensive Moringa Leaf Production

Whether produced for use as a green manure, for livestock or for human consumption, moringa can be grown intensively with yields of up to 650 metric tons of green matter per hectare.

These high yields were obtained through subsoiling to a depth of 60 cm (to encourage drainage and good root development), rotavating, then planting moringa at a 10x10 cm density (one million plants per hectare) with sufficient fertilizer (cow dung is preferred).

The green matter is harvested when plants reach a height of 50 cm or more (every 35-40 days), cut at a distance of 15-20 cm above the ground. The seedlings produce 3 or 5 new shoots after each cutting. Up to nine harvests can be obtained annually. In time the 15-20 cm stem will become thick and woody but will continue to send up green shoots.

Note from anamed: Increasingly we favour the proven agricultural methods promoted by Foundations for Farming (FfF), which is based in Zimbabwe. In contrast to the above, FfF favour zero till agriculture (i.e. no ploughing), and also constant soil cover which they nickname “God’s blanket”, see

www.foundationsforfarming.org/Group/Group.aspx?ID=104832 and click on “A Brief Summary of Foundations for Farming”.

Moringa As Livestock Feed

BIOMASA conducted extensive trials using moringa leaves as cattle feed (beef and milk cows), swine feed, and poultry feed. With moringa leaves constituting 40-50% of feed, milk yields for dairy cows and daily weight gains for beef cattle increased 30%. Birth weight, averaging 22 kg for local Jersey cattle, increased by 3-5 kg.

The high protein content of moringa leaves must be balanced with other energy food. Cattle feed consisting of 40-50% moringa leaves should be mixed with molasses, sugar cane, young elephant grass, sweet (young) sorghum plants, or whatever else is locally available. The maximum protein and fiber content of livestock feed should be:

	<u>Protein</u>	<u>Fiber</u>
Lactating cow:	18%	26-30%
Beef cow:	12-14%	36%
Lactating sow:	16-18%	5-7%
Meat pig:	12-14%	5-7%

Care must be taken to avoid excessive protein intake. Too much protein in pig feed will increase muscle development at the expense of fat production. In cattle feed, too much protein can be fatal (from alteration of the nitrogen cycle).

Cattle were fed 15-17 kg of moringa daily. Milking should be done at least three hours after feeding to avoid the grassy taste of moringa in the milk.

With moringa feed, milk production was 10 liters/day.

Without moringa feed, milk production was 7 liters/day.

With moringa feed, daily weight gain of beef cattle was 1,200 grams/day. Without moringa feed, daily weight gain of beef cattle was 900 grams/day.

The higher birth weight (3-5 kg) can be problematic for small cattle. It may be advisable to induce birth 10 days prematurely to avoid problems. Incidence of twin births also increased dramatically with moringa feed: 3 per 20 births as opposed to the usual average of 1:1000

Other research and experience

Experience with chickens: Chapter 14 includes a description of how Mr Asare in Ghana uses moringa to great advantage with his chickens.

Research undertaken in The Gambia⁵ with *Moringa oleifera* shows

- that biomass yields in excess of 15 tonnes dry matter per hectare can be produced in a 60 day growing cycle⁶.
- that where sources of dietary protein (e.g. groundnut cake) are becoming increasingly expensive and difficult to access, moringa offers a possible alternative.

The trials conducted indicated that crossbred cattle fed with Moringa as a supplement to a diet based on groundnut hay had a comparable growth rate to those fed with groundnut cake based concentrate, and a higher growth rate than those fed only with groundnut hay.

Other research in Nicaragua conducted by Nadir Reyes Sanchez indicated that the best way to grow Moringa for maximum biomass and nutrition was in high densities at 50-75 plants per square meter, and harvested at 75 day intervals.⁷

An additional use: Moringa leaves are excellent for biogas production.

⁵ Akinbamijo O. O., Adediran S. A., Nouala S. and Saecker J., “*Moringa* fodder in ruminant nutrition in The Gambia”, International Trypanotolerance Centre, P. M. B. 14, Banjui, The Gambia. See www.moringanews.org

⁶ For more information about the intensive cultivation of moringa, see Caroline Olivier, “Intensive *Moringa Oleifera* Cultivation in the North of Senegal”. See www.moringanews.org

⁷ www.tfljournal.org/gateway.php?what=history&lid=20060523125406470

10. Field Guide for Emergency Water Treatment with *Moringa oleifera*⁸

Text by Beth Doerr, ECHO Staff, March 2005



Introduction

Using natural materials to clarify water is a technique that has been practiced for centuries and of all the materials that have been used, seeds of the Moringa tree have been found to be one of the most effective. Studies have been conducted since the 1970's to test the effectiveness of Moringa seeds for treating water. These studies have confirmed that the seeds are highly effective in removing suspended particles from water with medium to high levels of turbidity (Moringa solutions are less effective at treating water with a low level of turbidity).

Theory

Moringa oleifera seeds treat water on two levels, acting as both a coagulant as well as an antimicrobial agent. It is generally accepted that Moringa works as a coagulant due to positively charged, water-soluble proteins which bind with negatively charged particles (silt, clay, bacteria, toxins, etc) allowing the resulting "flocs" to settle to the bottom or be removed by filtration. The antimicrobial aspects of Moringa continue to be researched.

Findings support recombinant proteins both removing microorganisms by coagulation as well as acting directly as growth inhibitors on the microorganisms. While there is ongoing research being conducted on the nature and characteristics of these components, it is accepted that Moringa treatment will remove 90-99.9% of the impurities in water.

Water Treatment

Solutions of Moringa seeds for water treatment may be prepared from either seed kernels or from the solid residue left over after oil extraction (presscake). Moringa seeds, seed kernels or dried presscake can be stored but solutions for treating water should be prepared fresh each time.

To treat 10 liters of water: Remove the outer coating from mature Moringa seeds and crush the white kernels to obtain a fine powder (do not use discolored seeds). Add 5 ml (1 level teaspoon) of powder to 250 ml (1 cup) of clean water and shake for 1 minute to activate the coagulant properties. Filter this solution through a clean cloth into the 10 liters of water to be treated. Stir the water rapidly for at least 1 minute, then slowly (15 to 20 rotations per minute) for 5-10 minutes. Let the water sit without disturbing for at least one hour. After the particles and contaminants have settled, the clear water from the top can be used.

Dosage Rates:

Low turbidity	1 seed per 4 liters water
Medium turbidity	1 seed per 2 liters water
High turbidity	1 seed per 1 liter water
Extreme turbidity	2 seeds per 1 liter water

10 Steps for Household Water Treatment

1. Collect mature *Moringa oleifera* seed pods and remove seeds from pods.
2. Shell seeds (remove seed coat) to obtain clean seed kernels. Discard discoloured seeds.
3. Determine the number of seeds needed given the amount and turbidity of the water.
4. Crush seed kernels (using grinder or mortar & pestle) and sift the powder through a screen or small mesh.
5. Mix fine seed powder with clean water to form a paste. In general, one seed kernel will treat one liter of water.
6. Mix the paste and 1 cup of clean water into a bottle and shake for 1 minute to form a solution.

⁸ Taken from: http://www.echocommunity.org/resource/collection/E66CDFDB-0A0D-4DDE-8AB1-74D9D8C3EDD4/Moringa_Water_Treatment.pdf

7. Pour this solution through a muslin cloth or fine mesh screen (to remove insoluble materials) into the water to be treated.
8. Stir treated water rapidly for at least 1 minute and slowly for 5-10 minutes.
9. Let the water sit without disturbing for 1-2 hours.
10. When the solid materials have settled to the bottom, the clean water can be carefully poured off.
11. The clean water can then be filtered or sterilized to make it completely safe for drinking, using one of the following methods:
 - a. Sand filters: See <http://practicalaction.org/bio-sand-water-filters>
 - b. Solar Sterilization: See <http://www.sodis.ch/>
 - c. Chlorination: 1-2 drops per liter
 - d. Boiling: 5 minutes minimum



Dangers

Secondary Infection: The process of shaking and stirring must be followed closely to activate the coagulant properties; if the flocculation process takes too long, there is a risk of secondary bacteria growth during flocculation.

Recontamination: The process of settling must be followed closely and the clear water should be poured /filtered off for use. The sediment at the bottom contains the impurities so care must be taken to use only the clear water and not allow the sediment to contaminate the cleared water.

Additional contaminants: Moringa treatment does not remove 100% of water pathogens. It is acceptable for drinking only where people are currently drinking untreated, contaminated water.

Additional Notes

Seeds of the *Moringa stenopetala* have been found to be more effective than the *Moringa oleifera* for purifying water.

Some studies have found that the levels of the active components in Moringa seeds were lower in the rainy season suggesting that seeds for water purification should be collected during the dry season.

For water with medium turbidity levels, 2 trees could supply sufficient seeds for water treatment for a family of five.

Relevant Websites

- www.jalmandir.com/
- www.lboro.ac.uk/well/resources/technical-briefs/technical-briefs.htm
- www.who.int/household_water/en/
- www.safewaterintl.org/
- www.le.ac.uk/engineering/staff/Sutherland/moringa/moringa.htm
- www2.lwr.kth.se/Publikationer/PDF_Files/LWR_PHD_1013.pdf
- www.safewatertrust.com/

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Additional note from Keith Lindsey of anamed: In April 2005 I visited Kendu Bay, in Kenya on the shore of Lake Victoria.. There had been recent rains, and the lake water was full of sediment, so much so that the tea tasted of earth, until we clarified the water in this way – and it clarified immediately! Then the tea was superb, and the entire seminar group was astonished – and absolutely delighted. (See picture above – ex army captain Juma Saidi drank the clear water immediately.)

11. Summary of other non-medicinal benefits of Moringa

Moringa's leaves, flowers, bark, wood and roots are used worldwide for a large variety of medicinal purposes. According to "The moringa tree: A local solution to malnutrition?" by Lowell J. Fugli, other uses for Moringa include:

Alley cropping: With their rapid growth, long taproot, few lateral roots, minimal shade and large production of high-protein biomass, Moringa trees are well-suited for use in alley cropping systems.

Biogas: Moringa leaves provide an excellent material for production of biogas.

Dye: The wood yields a blue dye which is used in Jamaica and in Senegal.

Fencing: Moringa trees are used as a live support for fencing around gardens and yards.

Foliar nutrient: Juice extracted from the leaves can be used to make a foliar nutrient capable of increasing crop yields by up to 30%.

Green Manure: Cultivated intensively and then ploughed back into the soil, Manure can act as a natural fertilizer for other crops.

Gum: The gum produced from a cut tree trunk has been used in calico printing, in making medicines and as a bland-tasting condiment.

Honey clarifier: Powdered seeds can be used to clarify honey without boiling. Seed powder can also be used to clarify sugar cane juice.

Honey producer: Flowers are a good source of nectar for honey-producing bees.

Livestock feed: The high bioavailability of Moringa leaves and stems make them an excellent feed for cattle, sheep, goats, pigs and rabbits.

Ornamental: Moringa trees are sometimes planted in gardens and along avenues as ornamental trees.

Plant disease prevention: Working Moringa leaves into the soil before planting can prevent fungal diseases in seedlings.

Pulp: The soft, spongy wood makes poor firewood, but the wood pulp is highly suitable for making newsprint and writing paper.

Rope making: The bark of the tree can be beaten into a fibre for production of ropes or mats.

Tannin: The bark and gum can be used in tanning hides.

Water purification: Powdered seed kernels act as a natural flocculent and can clarify even turbid water.

12. Design for a possible flyer about moringa

Many thanks to Markus Haebele and Bol Jodor in Sudan and Manfred Schiess in Germany who designed the following leaflet. Photocopy it, or use it as a guide to design your own!

10b) Alternatively allow the tree to grow to a height of 1 metre, and then cut back by 30 cm. The leaves can be used as food, and the stems fed to animals or composted.

Moringa stenopetala should be allowed to grow somewhat higher.

The leaves of *Moringa stenopetala* should not be eaten more than twice a week.

Moringa leaves may be consumed as:

- a cooked vegetable.
- dried leaf powder.
- tea.

Tips for a good harvest:

- a) plant groundnuts, beans or soya in rows between the moringa trees.
- b) if the moringa trees are attacked by insects or fungus, soak neem leaves in water and spray the moringa plant with this water.

Moringa as green manure

Plant moringa seeds at 10cm intervals and when the seedlings are about 15cm high work them into the soil. Then your next crop of vegetables or other plants should really thrive!

Moringa as animal feed

Moringa leaves may be mixed with your usual animal feed. Cows put on more weight and give more milk.

To purify water

If necessary filter the dirty water. Crush several white moringa seed kernels, shake vigorously in a little clean water in a bottle, then pour through a filter cloth into the dirty water and stir slowly.

Leave to settle.

Encourage each family to plant 10 moringa trees in their garden for their good health and as a defence against malnutrition.

Moringa leaves are not only good for children. Pregnant women and breast feeding mothers benefit enormously from the strength and good health provided by moringa leaves.

What makes moringa such a powerful source of nutrition?

VITAMINS

Vitamin A is important for eye sight. Lack of Vitamin A can even cause blindness.

Vitamin C fights against many sicknesses like colds...

MINERALS

Iron is very important especially for pregnant women and breastfeeding mothers and people suffering from malaria, anaemia or bilharzia.

Calcium builds strong bones and teeth.

Potassium helps the brain and nerves to function well.

PROTEINS

Proteins are very important for the growth and the health of the whole body.

These remarkable leaves contain many more valuable nutrients.

This leaflet has been produced by anamed international with thanks to Markus Haefele and Manfred Schiess. A booklet available from anamed international provides more information on moringa, as does the anamed home-page under "Downloads".

www.anamed.net

Moringa

A real lifesaver!

Moringa oleifera and Moringa stenopetala can help us to:

- end malnutrition
- help HIV patients
- purify water

Moringa oleifera leaves look like this:



Moringa leaves are extremely nutritious, more so than almost any other tropical plant.

These leaves contain many vitamins, many proteins and many minerals.



Moringa leaves are a strong body-building food.

The powder made from dried Moringa leaves is sold in pharmacies in many African countries.

How to make Moringa leaf powder:

1. Wash the leaves
2. Strip them off from the stems

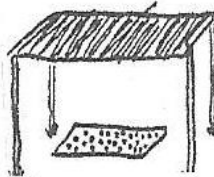


3. Spread them out on something clean (e.g. on a sack, a piece of material or on a tray)



4. Dry them in the shade

(e.g. in the house, or covered with a piece of material). This is important because direct sunlight destroys vitamins.



Let the leaves dry completely (about 2 days)



5. Pound the leaves well in a mortar to produce leaf powder. Then sieve the powder to remove the remaining stems.

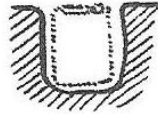
6. Keep the leaf powder in a clean and closed container

(e.g. a jam jar with a screw top lid). If the powder is really dry it will keep for months. This is important towards the end of the dry season when the Moringa tree has no leaves. It makes cooking with Moringa also very easy. **To all kinds of food just add a heaped teaspoon of moringa leaf powder three times each day.**



How to plant Moringa seeds or seedlings:

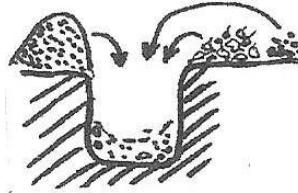
1. Choose a sunny place for the tree away from the street to avoid dust and pollution.



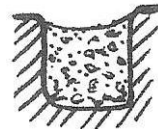
2. Dig a hole which is so big that you can at least put a jerry can in it.

3. Fill the hole with compost, leaves of other trees and, if available, well-rotted manure of cows, goats or donkeys. Mix well.

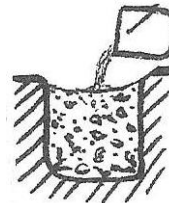
(If you don't have compost, bring some soil from a place where other plants grow well. Dark earth is usually the best. Add leaves and manure.)



4. Don't fill the hole completely. Leave a hollow so that, when watering, the water does not flow away.



5. Pour 1 or 2 buckets of water into the hollow. Wait until all the water has disappeared.



6a) If you use seeds:

Make a small hole in the middle of the pit by pressing your finger into the soft soil, just until you cannot see your fingernail any more (about 1 or 2 cm deep). Put the seed



in the small hole and cover it with soil.

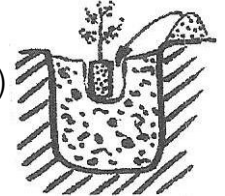


6b) If you use seedlings:

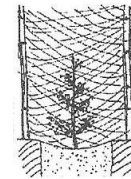
Make a hole larger than the bag that holds the seedling. Carefully cut the plastic bag at the side and on the bottom with a sharp knife. Put the seedling in the prepared hole, whilst care fully removing the plastic



bag. Make sure the soil and the roots don't break. (This is easier if someone helps you.) Fill the space around the seedling with soil.

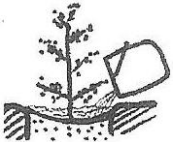


7. Protect the small tree from cats, dogs, goats and playing children. In the first month provide a bit of shade. You could use some thorns or bamboo with chicken wire.



8. Water daily for the first 2 weeks.

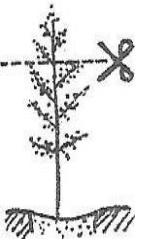
The soil should not completely dry out, but neither should it be too wet. If the earth becomes water-logged the seeds and roots will simply go rotten.



9. After about 3 months you can start to harvest your first leaves. Start from the bottom. Let the newest leaves remain.



10a) Cut the tree when it is about 60 cm high. Cut about 20 cm off the top. This makes the tree produce more branches and leaves. As the tree again cut the branches back again and again to give a good harvest of leaves.



13. Case Study: Moringa and Malnutrition: A Project in Senegal

The late Lowell Fuglie led a project in 1997-98 in south western Senegal to assess the ability of Moringa leaf powder to prevent or cure malnutrition in pregnant or breast-feeding women and their children. 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.

Moringa was already growing wild in the district. They found that people were very willing to try adding moringa leaf powder to their food, and then when they had a positive experience they were willing to plant moringa trees in their own gardens.

Many patients who took Moringa leaf powder enjoyed the following benefits:

- Children maintained or increased their weight and improved overall health.
- Pregnant women recovered from anaemia and had babies with higher birth weights.
- Breast-feeding women increased their production of milk.

Impressive aspects of this study:

- The project became self-sustaining. People now realise the necessity of having their own trees since Moringa is now considered to be a precious commodity (owners of trees no longer allow their neighbours to harvest them).
- There is a good level of awareness about the properties and ways of using Moringa, both among health agencies and within local communities.
- Moringa leaf powder was found to be available in more than half the health posts visited.
- The value attached to Moringa has been enhanced by the fact that health agencies prescribe it and offer the powder for sale in pharmacies.
- A reduction in levels of infant malnutrition in the region, noted by health agencies and other persons interviewed and verified by statistics kept between 1998 and 1999 by the health post in Niaguis.

The video produced by ECHO (see Bibliography) shows several people who participated in this project in Senegal and who give an account of the ways in which they benefited. For example, as indicated above, malnourished babies and young children were healed and at the same time other problems such as diarrhoea disappeared. Pregnant mothers who ate moringa enjoyed much better health; not only did their babies have higher birth weights but the mothers were cured of various health complaints, e.g. skin problems. A diabetic described how his sugar levels were stabilised.

In this region of Senegal moringa leaf powder became very much preferred to the other products which were commonly used to combat malnutrition, which were milk powder, sugar and vegetable oil. These had had to be imported and were costly – whereas moringa, grown in one's own garden, costs nothing and enables people to stand on their own two feet.

More information is given in the chapter “Combating Malnutrition with Moringa” in the book “The Miracle Tree” (see Bibliography).

14. Case study: Ghana

In Ghana the moringa tree is well-known but little understood. There are, however, a few people there with a vast experience. We present some of their experience here, and invite you to tell us about yours.

Notes from George Zokli in Tema

Moringa oleifera grows well in the desert. It is very drought resistant. Often used for fences. Can grow up to 15 metres.

Moringa is called “never die”, because the more you cut the more it grows. You can even cut the main stem. It is also called “mother’s best friend” because it is very nutritious.

Moringa is a nutritious food and medicine, it nourishes and treats animals including fish, it improves the soil and is used to purify water.

Notes from Mr Asare in Kumasi

1. After taking moringa leaf powder regularly, several older people who used to struggle to get out of bed in the morning now leap out of bed with no problem at all.
2. Moringa leaf powder brings the sugar levels of diabetic patients right down.
3. He treats epileptics with 50% leaf powder and 25% root. The other 25% is seeds which he gives separately.
4. Many children who had skin problems now have healthy skin with moringa soap.
5. He himself suffers from MS and moringa leaf powder has stabilised it.
6. Mr Asare has a chicken farm. He adds 1 kg of leaf powder to 1 ton of chicken feed. In the afternoon he gives them an extra amount of fresh leaves – he finds that this stops the chickens pecking each other due to the extra vitamins in the fresh leaves.



Moringa trees that have been cut back and which are now producing many branches with many leaves.

In conjunction with a university in Germany he is making a comparative study of a) chickens with no moringa, b) chickens with moringa leaf powder in the feed and c) this plus fresh moringa leaves in the afternoon.

The chickens eat moringa, and he uses the chicken manure to fertilise the moringa trees!

He purifies the water from the well that he gives to the chickens with moringa seeds. He pulverises the seeds and stirs it into the water at 4p.m. and leaves the water overnight to settle out.

With moringa the laying chickens lay eggs with strong shells and very yellow yolks.

15. *Moringa oleifera*

From the database of the World Agroforestry Centre

www.worldagroforestry.org/treedb/AFTPDFS/Moringa_oleifera.pdf

Taxonomy

Current name: *Moringa oleifera*

Family: Moringaceae Authority: Lam.

Common names

Amharic (shiferaw); Arabic (rawag); Bengali (sajina,sohjna,sujina); Burmese (dandalonbin,dan-dalun); Cantonese (nugge); Creole Patois (benzolive tree); English (ben-oil tree, cabbage tree, clarifier tree, drumstick tree, horse-radish tree, moringa tree, West Indian ben); Filipino (malunggay); French(acacia blanc, Ben ailé, moringa ailé, Neverdie, Pois quenique); German (Meerrettichbaum, Pferderettichbaum); Gujarati (midho-saragavo); Hausa (zogallagandi); Hindi (munga ara, mungna, sainjna, sanjna,shajna, sohanjna, sondna, suhujna); Igbo (okwe oyibo); Indonesian (kelor); Lao (Sino-Tibetan) ('ii h'um); Malay (merunggai, sajina); Mandinka (nebedayo); Nepali (shobhanjan, sohijan); Sanskrit (shobhanjana); Spanish (paraíso blanco, paraíso frances, reseda); Swahili (mlonge, mronge, mrongo, mzunze); Tamil (murangai, murunga); Thai (makhonkom, ma-rum, phakihum); Urdu (sahjnao); Vietnamese (chùm ngây); Yoruba (ewe-igbale)

Botany

Moringa oleifera is a small, graceful, deciduous tree with sparse foliage, often resembling a leguminous species at a distance, especially when in flower, but immediately recognized when in fruit. The tree grows to 8 m high and 60 cm dbh. Bole crooked, often forked from near the base. Bark smooth, dark grey; slash thin, yellowish. Twigs and shoots shortly but densely hairy. Crown wide, open, typically umbrella shaped and usually a single stem; often deep rooted. The wood is soft.

Leaves alternate, the old ones soon falling off; each leaf large (up to about 90 cm long), with opposite pinnae, spaced about 5 cm apart up the central stalk, usually with a 2nd lot of pinnae, also opposite, bearing leaflets in opposite pairs, with a slightly larger terminal leaflet. Leaflets dark green above and pale on the under surface; variable in size and shape, but often rounded-elliptic, seldom as much as 2.5 cm long.

Flowers produced throughout the year, in loose axillary panicles up to 15 cm long; individual flower stalks up to 12 mm long and very slender; 5 pale green sepals 12 mm long, finely hairy, 5 white petals, unequal, a little longer than the sepals; 5 stamens with anthers, 5 without; style slender, flowers very sweet smelling.

Fruit large and distinctive, up to 90 cm long and 12 mm broad, slightly constricted at intervals, gradually tapering to a point, 3- (4-) angled, with 2 grooves on each face, light brown. It splits along each angle to expose the rows of rounded blackish oily seeds, each with 3 papery wings.

The generic name comes from the Sinhalese name 'morunga'.

Domestication

Throughout India, *Moringa* is commonly cultivated in hedges and backyards because of its usefulness as a fodder tree and its remarkable capacity to stand maltreatment.

Ecology

Readily colonizes stream banks and savannah areas where the soils are well drained and the water table remains fairly high all the year round. It is quite drought tolerant but yields much less foliage where it is continuously under water stress. It is not harmed by frost, but can be killed back to ground level by a freeze. It quickly sends out new growth from the trunk when cut, or from the ground when frozen.

Biophysical limits

Altitude: 0-1 000 m, Mean annual temperature: 12.6 to 40 deg. C, Mean annual rainfall: At least 500 mm

Soil type: A adapted to a wide range of soil types but does well in well drained clay or clay loam without prolonged waterlogging. Prefers a neutral to slightly acidic soil reaction, but it has recently been introduced with success in Pacific atolls where the pH is as high as 8.5.

Native Range

India, Malaysia, Oman, Qatar, Saudi Arabia, United Arab Emirates, Yemen, Republic of

Exotic Range

Afghanistan, Bangladesh, Benin, Burkina Faso, Cameroon, Chad, Eritrea, Ethiopia, Gambia, Ghana, Guinea, Haiti, Indonesia, Iran, Kenya, Kiribati, Liberia, Mali, Marshall Islands, Mauritania, Myanmar,

Nepal, Niger, Nigeria, Northern Mariana Islands, Pakistan, Philippines, Senegal, Sierra Leone, Sudan, Tanzania, Thailand, Togo, Uganda, Vietnam, Zanzibar

Reproductive Biology

The bisexual, oblique, stalked, axillary and heteromorphic flowers are highly cross-pollinated due to heteromorphism. The carpenter bees (*Xylocopa latipes* and *X. pubescens*) have been found the most reliable and appropriate pollinators. Sunbirds *Nectarinia zeylanica* and *N. asiatica* have also been observed to be active pollinators.

Propagation Methods

M. oleifera is easily established by cuttings or by seeds. Seeds can be sown either directly or in containers. No seed pretreatment is required and seeds sprout readily in 1-2 weeks. Plants raised from seed produce fruit of unpredictable quality. Shield budding is successful, and budded trees begin to bear in 6 months and continue to give a good crop for 13 years. As it is essentially a vegetatively propagated crop, breeding methods like single-plant selection, mass selection and exploitation and maintenance of vigour are transgressive. Stem cuttings are usually preferred because they root easily. When grown for its roots, the seeds are sometimes planted in rows like vegetables.

Tree Management

Moringa is an extremely fast-growing tree, and within 1-3 months trees reach 2.5 m. Constant pruning of up to 1.5 m/year is suggested to obtain a thick-limbed and multibranched shrub. Trees are commonly grown for their leaves, and topping-out is useful to keep an abundant supply of leaves, pods and flowers within easy reach. *M. oleifera* responds well to mulch, water and fertilizer. Growth is stunted in areas with a high water table. It coppices and pollards well.

Germplasm Management

Seed storage behaviour is orthodox; viability can be maintained for several years in hermetic storage at 3 deg. C with 5-8% mc. Seeds should be collected from well-developed pods, but difficulties arise because seeds drop continually.

Products

Food: The leaves, a good source of protein, vitamins A, B and C and minerals such as calcium and iron, are used as a spinach equivalent. They are an excellent source of the sulphur-containing amino acids methionine and cystine, which are often in short supply. Young plants are eaten as a tender vegetable and the taproots as an alternative for horseradish. Young pods are edible and reportedly have a taste reminiscent of asparagus. The green peas and surrounding white material can be removed from larger pods and cooked in various ways. Seeds from mature pods (which can be 40-50 cm long) can be browned in a skillet, mashed and placed in boiling water, which causes an excellent cooking or lubricating oil to float to the surface. The pleasantly flavoured edible oil, resembling olive oil, is an excellent salad oil. The flowers can be eaten or used to make a tea.

Fodder: Leaves are mainly used for human food and not to any great extent for livestock, but branches are occasionally lopped for feeding camels and cattle.

Apiculture: Its silviculture, involving regeneration by cuttings, coppicing and pollarding, keeps flowering on and off most parts of the year. This provides nectar to honey bees for a long period.

Fuel: The soft and light wood is an acceptable firewood for cooking but makes poor charcoal. It has a density of 0.5-0.7 and yields approximately 4600 kcal/kg.

Fibre: Bark, when beaten, produces a fibre used to make small ropes and mats. A study on the production of rayon-grade pulp from *M. oleifera* by a prehydrolyzed sulphate process in India shows that it is suitable as a raw material for the production of high alpha cellulose pulp for use in cellophane and textiles.

Timber: The wood is very soft and light and is useful only for light construction work.

Gum or resin: When the tree is injured, the stem exudes a gum that is used in calico printing, as a condiment, and for stomach and bladder ailments. The mucilaginous gum has a bland taste and belongs to the hog series of gums.

Tannin or dyestuff: Bark used for tanning hides and wood yields a blue dye.

Lipids: Oil extracted from the mature pods (oil of Ben) is yellowish, non-drying, good keeping qualities but eventually turns rancid. It is used as a lubricant, in cosmetics and perfumes, and to some extent is a substitute for sperm-whale oil.

Medicine: Moringa seeds are effective against skin-infecting bacteria *Staphylococcus aureus* and *Pseudomonas aeruginosa*. They contain the potent antibiotic and fungicide terygospermin. The alkaloid spirachin (a nerve paralyzant) has been found in the roots. Even when free of bark, the condiment in excess may be harmful. A decoction of the flowers is used as a cold remedy. The gum is diuretic, astringent and abortifacient and is used against asthma. Oil of Ben is used for hysteria,

scurvy, prostate problems and bladder troubles. The roots and bark are used for cardiac and circulatory problems, as a tonic and for inflammation. The bark is an appetizer and digestive. The iron content of the leaves is high, and they are reportedly prescribed for anaemia in the Philippines. Other products: In the Sudan, powdered seeds are deemed more effective than slices of okra (*Abelmoschus esculentus*) for treatment of bee honey; they can be used without boiling and can also be used to clarify sugarcane juice. The crushed leaves are used to clean pots and pans, and the Hausa and Yoruba of Nigeria even use them to clean walls.

Services

Erosion control: *M. oleifera* is suited to areas where strong winds and long, dry spells occur simultaneously, causing serious soil erosion.

Soil improver: The green leaves make a useful mulch. The press cake left after oil extraction from the seeds can be used as a soil conditioner or as fertilizer.

Ornamental: The species is widely planted as an ornamental.

Boundary/barrier/support: Planted as a hedge in courtyards, *M. oleifera* provides wind protection, shade and support for climbing garden plants. Widely used for live fences and hedges in Kenya, Nigeria, Tanzania, India, and elsewhere. Stakes root easily and are stable, and cuttings planted in lines are used particularly around houses and gardens.

Intercropping: The tree provides semi-shade, useful in intercropping systems where intense direct sunlight can damage crops.

Pollution control: Suspension of the ground seed of *M. oleifera*, the benzolive tree, is used as a primary coagulant. It can clarify water of any degree of visible turbidity. At high turbidity, its action is almost as fast as that of alum, but at medium and low turbidity, good clarification is obtained if a small cloth bag filled with the powdered seeds is swirled round in the turbid water. To prepare the seed for use as a coagulant, remove the seed coat and wings. The white kernel is then crushed to a powder, using a mortar or placing it in a cloth and crushing it with a stone. The powder should be mixed with a small amount of water, stirred, then poured through a tea strainer before being added to the turbid water.

16. *Moringa stenopetala*

From the database of the World Agroforestry Centre

www.worldagroforestry.org/treedb/AFTPDFS/Moringa_stenopetala.pdf

Taxonomy

Current name: *Moringa stenopetala*

Family: Moringaceae

Common names

Amharic: haleko, shifara; English: cabbage tree

Synonyms

Donaldsonia stenopetala Bak.f

Moringa peregrina non (Forssk.) Fiori

Moringa streptocarpa Chiov

Botany

Moringa stenopetala is a tree 6-12 m tall having a diameter of 60cm (DBH) and a smooth bark; its crown is strongly branched, sometimes with several trunks, and its wood is soft.

The leaves are bi- or tri-pinnate, with about 5 pairs of pinnae and 3-9 elliptic to ovate leaflets per pinna.

The flowers are very fragrant with cream flushed pink sepals, white, pale yellow or yellow-green petals, white filaments and yellow anthers. The ovary is ovoid and densely hairy.

Pods are elongate reddish with greyish bloom having grooved valves.

Ecology

M. stenopetala grows naturally in the Acacia tortilis-Delonix elata-Commiphora spp. vegetation-complex. This type of vegetation is often found in well-drained soils at altitudes of 900-1200 m. The species is quite drought resistant. In southern Ethiopia, it has been found in areas of mean annual rainfall ranging from 500-1400mm. Cold temperatures are limiting factor for the cultivation of the species in Ethiopia because it does not tolerate frost.

Biophysical limits

Altitude: 0-2100 m.

Mean annual temperature: 24-30 deg C.

Mean annual rainfall: 500-1400 mm

Soil type: The species does not have any specific soil requirements, except it does not grow on waterlogged or swampy soils. The soil PH ranges from acidic to alkaline but mostly exhibit neutral reaction.

Native Range

Ethiopia, Kenya, Somalia

Propagation Methods

The most common method of propagating *M. stenopetala* is by direct sowing without pre-treatment of seed. Some farmers occasionally propagate the species by using branch-sized cuttings.

Germplasm Management

Cold temperatures inhibit seeds of *M. stenopetala*; under low temperatures (at and below 15 deg C) an enforced dormancy has been found to occur.

The speed of germination of untreated seeds depends on temperature, humidity and watering.

Seeds placed at 8 deg. C in a refrigerator for 24 hours before sowing showed 88% germination in an experiment.

The seeds remain viable for several years as evidenced by germination rates of 96-98% recorded for 44 month-old seeds.

Products

Food: The leaves and fruits are eaten as vegetables and are rich in proteins, calcium, iron, phosphorous as well as vitamins A and C.

Fodder: The use of leaves and pods for animal fodder is currently of minor importance compared to their use for human consumption. Yet, due to their high protein content this is a promising potential use.

Fuel: Growing rapidly, these trees have softwood that is not particularly suitable for fuel. But because the supplies are so scarce, it is often used as a fuel in its natural range.

Services

Ornamental: It is a valued ornamental in its natural range.

Boundary or barrier or support: It serves as a live fence in areas of its natural range.

Intercropping: The species is grown in mixed multi-storey stands with food crops. The home gardens in Ethiopia (Arba Minch area) for instance, include at least 5, and sometimes up to 15 *M.*

stenopetala trees per 0.1 ha. Farmers practice long-term cultivation at different heights with *M. stenopetala* at the uppermost level, *Carica papaya*, coffee and bananas in the upper-middle level, cassava, maize and sugar cane in the lower-middle level and cotton and pepper in the lowest level.

Pollution control: One of the most promising potential uses of *M. stenopetala* is to purify turbid water. The seeds of this and some other species of the Moringaceae have flocculating and anti-microbial properties. The active substances are found only in the cotyledons of the seeds.

17. A Comparison of *Moringa oleifera* and *Moringa stenopetala*

	<i>Moringa oleifera</i>	<i>Moringa stenopetala</i>
Height	Up to 8 metres	6 – 12 metres. Everything is bigger, most notably the leaves.
Altitude	0 – 1000 metres	0 – 2100 metres
Mean annual temperature	13 – 40 °C	24 – 30 °C
Rainfall requirement	At least 500 mm	500 – 1400 mm
Habitat	Native to India – introduced all over Africa.	Native to Ethiopia, Kenya, Somalia
What they have in common	<ol style="list-style-type: none"> 1. Propagation: By cuttings or seeds 2. Vitamins, minerals and proteins in the leaves. 3. Medicinal uses. 4. The water clarification properties of the seeds. 	



A range of well-labeled moringa products in Ghana, mainly leaf powder and soaps

18. Phytochemical constituents and research studies

Main sources for the information in this chapter

1. "All things Moringa: The Story of an Amazing Tree of Life" by H. Hiawatha Bey, see <http://allthingsmoringa.com/eBook.pdf>
2. "Moringa: Nature's Medicine Cabinet" by Sanford Holst, Sierra Sunrise Publishing, 2000
3. "Moringa oleifera: A Review of the Medical Evidence for Its Nutritional, Therapeutic, and Prophylactic Properties. Part 1", (2005) by Jed W Fahey. See www.tfljournal.org/article.php/20051201124931586
4. "Moringa Tree of Life", see www.moringatreeoflife.com/About_Moringa.html

Moringa constituents with hypotensive and antibacterial activity:

4-(A-L-Rhamnopyranosyloxy) Benzyl isothiocyanate
Pterygospermin
Benzyl isothiocyanate
4-(A-L-Rhamnopyranosyloxy) benzyl glucosinolate

Other components have been shown to have anti-cancer activity:

4-(4'-O-Acetyl-A-L-Rhamnopyranosyloxy) Benzyl isothiocyanate
Niazimicin

Pterygospermin has been shown to readily dissociate into two molecules of **Benzyl isothiocyanate**, which is also found in roots and seeds and has bactericidal and fungicidal properties.

More specifically, the **isocyanates** in Moringa have been shown to have antibiotic activity against *Helicobacter 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. *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).

Moringine and Moringinine are alkaloids found in Moringa root bark. Moringinine acts as a cardiac stimulant and causes an increase in blood pressure. Patients with high blood pressure must therefore avoid consumption of moringa root bark. Moringinine also relaxes bronchioles (bronchial tube inflammation) and inhibits involuntary intestinal tract movement.

Anthonine, which is also found in root bark, is highly toxic to the cholera bacterium.

Carotenoids (including b-carotene or pro-vitamin A) are more commonly recognized phytochemicals found in the leaves.

Spirochin, found in the roots, is antibacterial, analgesic, antipyretic, affects the circulatory system (by raising or lowering heart beat, depending on dose), and affects the nervous system. In high doses it can paralyze the vagus nerve (an important nerve connecting the brain to many body organs).

Chlorophyll: Moringa is one of the few foods that contain chlorophyll. Chlorophyll supports liver function and detoxification of the body.

Beta-sitosterol: Beta-sitosterol is a specific plant sterol which has been shown to reduce blood cholesterol levels and also improve other blood lipid levels, bringing them to a more normal range. Plant sterols like beta-sitosterol are also proven to be very beneficial in preventing and treating prostate enlargement due to aging, and have been found to reduce the growth of prostate and colon cancer cells. Beta-sitosterol also boosts the immune system, has anti-inflammatory properties, helps normalize blood sugar, supports the pancreas, helps to heal ulcers and can alleviate cramps.

Zeatin: Biochemical analysis has revealed that the Moringa leaves and leaf powder contain unusually high amounts of plant hormones named cytokinins, such as zeatin and the related dihydrozeatin. Scientists have found zeatin in very low concentrations in plants, with zeatin concentrations varying between 0.00002 mcg/g material to 0.02 mcg/g. The zeatin concentration in Moringa leaves is very high, between 5 mcg and 200 mcg/g material, or thousands of times more concentrated than most plants studied so far.

Cytokinins function as plant hormones, which are naturally occurring growth promoters and factors that delay the process of aging in many plants. Zeatin has potent antioxidant properties, and has been shown to protect the skin and increase the activity of known anti-oxidant enzymes that naturally fight aging. It has also been shown to protect animals against neuronal toxicity induced by age specific factors, and in the laboratory setting, to inhibit cancer cell growth and induce their differentiation back into normal cells.

Lutein: Moringa has extraordinary amounts of lutein. 100 g of leaves contain more than 70 mg, while the recommended daily amount for the best protective antioxidant activity is 5 – 20 mg for an adult. Lutein promotes healthy eyes by reducing the risk of macular degeneration.

Caffeoylquinic acids: Moringa leaves contain 0.5 – 1% caffeoylquinic acids. Caffeoylquinic acids are antioxidants considered to be choleric (bile increasing which helps to digest dietary fats), hepatoprotective (effective against hepatitis and other liver diseases), cholesterol-reducing, and diuretic.

NOTE: Complex mixtures of naturally occurring antioxidants from plants are the most effective and beneficial protectors against oxidation and aging. Moringa contains many other antioxidants including alpha carotene, xanthins, kaempferol, quercetin, and rutin.

Further studies that support medicinal experience with moringa

Moringa leaf extract has been shown to be effective in **lowering blood sugar levels** within a space of 3 hours. The effects increased with larger doses.

An extract taken from dried leaves showed an impressive ability to heal **gastric ulcers** in laboratory animals. Administration of daily doses by injection caused a very significant improvement in the healing rate in induced gastric ulcers.

An extract made from dried powdered leaves was shown to have a very potent **depressive effect on the central nervous system, resulting in significant muscle relaxation, decreased body temperatures and increased sleep time** among laboratory mice. Subjects receiving the highest dosages spent twice as much time asleep as the control group.

An extract from dried roots, applied orally to laboratory mice, demonstrated clearly that the roots possess **anti-inflammatory properties**. In another study, infusion of seeds, roots and flowers significantly inhibited the formation of **pedal oedema** (swelling of the tissues in the foot), although the authors concluded that the seeds may have the greatest effect.

An infusion made from seeds demonstrated an ability to **inhibit intestinal spasms**, as well as some **diuretic activity**. However, other plant parts (leaves, roots, stalks and flowers) showed no significant antispasmodic or diuretic activity.

An *in vitro* study showed that an aqueous extract made from seeds is effective against ***Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Escherichia coli***. This study showed the seed extract to be equally effective as Neomycin against *S. aureus*. Similar results were obtained with aqueous extracts from the roots. Fresh leaf juice has showed some positive inhibition of *Pseudomonas aeruginosa* and an extract from leaves was found to be effective at inhibiting the growth of the fungi *Basidiobolus haptosporus* and *B.ranarum*.

An aqueous extract from stem bark were shown to increase the rate of **heart contractions** at low concentrations and decrease the rate at high concentrations, with the effect of lowering blood pressure.

19. Bibliography – sources of more information

1. “Moringa News” www.moringanews.org/

This web-site is a source of a lot of background reading material on moringa, and it is constantly being revised and added to.

The aim of the international network MoringaNews is that *Moringa* products benefit the poorest people by contributing to their food security and health.

2. "Growing and processing moringa leaves" (2010) An excellent, well-illustrated book published by Moringa News and the Moringa Association of Ghana. It can be downloaded from the following link: www.moringanews.org/documents/moringawebEN.pdf

3. **Trees for Life international** has produced excellent materials on moringa, and an informative powerpoint presentation which may be downloaded free of charge. www.treesforlife.org/our-work/our-initiatives/moringa. They have produced a publication, which can be also downloaded free of charge, “Some call it a miracle. Could it also be good science?” [www.treesforlife.org/documents/moringa/English moringa book view.pdf](http://www.treesforlife.org/documents/moringa/English%20moringa%20book%20view.pdf)

4. “The Miracle Tree: The Multiple Attributes of Moringa”, (2001), Edited by Lowell Fuglie.

5. “Moringa: Nature’s medicine cabinet” by Sanford Holst, 2000, Sierra Sunrise Books. Available from ECHO. This book includes a long description of folk remedies of moringa.

6. **ECHO, Educational Concerns for Hunger Organization.** Echo's vision is to bring glory to God and a blessing to mankind by using science and technology to help the poor. Echo supplies ideas, information, training and seeds to those working in agriculture and development overseas.

ECHO, 17391 Durrance Rd, N. Ft. Myers, FL 33917-2239, USA. Email: echo@echonet.org
Tel: +1 239-543-3246 Web-site: www.echonet.org

7. **World Agroforestry Centre database** <http://www.worldagroforestry.org/>. Click on Information resources, and then Agroforestry Databases.

8. "*Moringa oleifera*: A Review of the Medical Evidence for Its Nutritional, Therapeutic, and Prophylactic Properties. Part 1” by Fahey, J W, Trees for Life Journal 2005, 1:5. Can be read at www.tfljournal.org/article.php/20051201124931586

9. “Quenching the thirst of millions in the world - application of processed *Moringa oleifera* seeds in drinking water treatment” by Suleyman Aremu Muyibi. Powerpoint presentation on moringa as a water clarifier. www.moringanews.org/documents/suleyman.ppt

10. **James A. Duke. 1983. Handbook of Energy Crops.** Unpublished but on the internet. www.hort.purdue.edu/newcrop/duke_energy/Moringa_oleifera.html



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113/	Book 3,"Nat. Medicine for teachers" Resource kit for seminar leaders 20 Euro	=€.....
115/	Book 4, "AIDS and Natural Medicine" 5 (4*/3**) Euro	=€.....
204/	Document 1: "Artemisia annua anamed: Cultivation and uses",8 (7*/5**) €	=€.....
220/	Document 2: "Artemisia annua anamed: From Research to Experience", 15 €	=€.....
403/	Colour poster of 60 tropical med.plants 70x100cm, folded or as roll ² , 6 (5*/4**) €	=€.....
440/	Colour poster of 60 tropical med.plants (70x50cm), 4 (3**) €	=€.....
419/	MORINGA documentation , 6 (5*/4**) €	=€.....
421/	MORINGA: documentation and each 30g of seeds of M. oleifera und stenopetala, 20 €	=€.....
107/	Book "USE WATERHYACINTH!" incl. instructions for solar oven constr., 7 (6*/5**) €	=€.....
117/	"NEEM in medicine and agriculture": Document 5(4*/3**) €	=€.....
201/	Document: »Mercury soaps: A Modern Day Scandal » 5(4*/3**) €	=€.....
450/	“Black is beautiful” 10 Posters DIN A3 about dangerous cosmetics, English, 8 (7*/6**) €	=€.....

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* price for at least 5 of this item in €.

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