Moringa

The Miracle Tree
Moringa - AKA

- Miracle Tree
- Drumstick Tree
- Horseradish Tree
- Ben Oil Tree
- West Indian Ben
- Mother’s Best Friend
- Tree that grows like crazy
- Radish Tree
Location, Location, Location

- India
- Africa
- Arabia
- South East Asia
- South America
- Pacific Islands
- Caribbean Islands
Growing Conditions

- Semi-Arid
- Hot
- No Frost
Currently Cultivated In

- tropical Africa
- tropical America
- Sri Lanka
- India
- Mexico
- Malaysia
- the Philippines
13 Moringa Species

- Slender Trees (India)
  - *M. oleifera* - subhimalayan India
  - *M. conanensis* – India & Pakistan to near Bangladesh
  - *M. peregrina* – Dead Sea to the Red Sea and beyond

- Bottle Trees (Southern Hemisphere)
  - *M. ovalifolia* – Namibia and Angola in S.W. Africa
  - *M. drouhardii* – Madagascar only
  - *M. hildebrantii* – Madagascar only
13 Moringa Species

- **African Horn Specific Species**
  - *M. pygmaea*
  - *M. longtituba*
  - *M. ruspoliana*
  - *M. rivae*
  - *M. boriziana*
  - *M. stenopetala* (widely cultivated)
  - *M. arborea*
Moringa oleifera ~ Most Effective
Botanical Details
Botanical Details

*Moringa.*
Embryo cut vertically (mag.).

*Moringa.*
Anther (mag.).

*Moringa.*
Seed, entire and cut vertically (mag.).

*Moringa.*
Diagram.

*Moringa.*
Ovule (mag.).

*Moringa.*
Flower (mag.).

*Moringa.*
Part of fruit cut vertically.

*Moringa.*
Flower cut vertically (mag.).

*Moringa.*
Flower-bud (mag.).
Many Uses of Moringa

- Water Treatment
- Nutritional Supplement
- Erosion Control
- Mechanical Lubricant
- Living Fence
- Lucky Charm
- Medicinal Uses
  - Lung & Body Tonic
  - Treatment for Epilepsy and Hysteria
  - Astringent
  - Digestive Aid
  - Aphrodisiac
Leaves are Tasty!* 

*Leaves are tasty when prepared into recipes in small doses
Nutritional Comparison

*Moringa* Compared to 100gm. Edible Portion of Common Foods

from *Nutritive Value of Indian Foods* by C. Gopalan, et al.

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Moringa</th>
<th>Other Foods</th>
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</thead>
<tbody>
<tr>
<td>Vitamin A</td>
<td>6780 mcg</td>
<td>Carrots: 1890 mcg</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>220 mg</td>
<td>Oranges: 30 mg</td>
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<tr>
<td>Calcium</td>
<td>440 mg</td>
<td>Cow’s milk: 120 mg</td>
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<tr>
<td>Potassium</td>
<td>259 mg</td>
<td>Bananas: 88 mg</td>
</tr>
<tr>
<td>Protein</td>
<td>6.7 gm</td>
<td>Cow’s milk: 3.2 gm</td>
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</tbody>
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As you can see, the Moringa tree is a powerful source of vitamins.
Leaves: Nutritional Supplement

Gram for Gram
Moringa Leaves
Provide

- 7 times the vitamin C in oranges
- Plus: 3 times the potassium in bananas
- Plus: 4 times the calcium in milk
- Plus: 4 times the vitamin A in carrots
- Plus: 2 times the protein in milk
Marketable Moringa
Now for what you’ve been waiting for...

What does this have to do with water treatment?
Seeds: Coagulant

- The seeds of the Moringa tree contain a cation, which acts as a coagulant in turbid water.
- Seed powder is as effective as technical, non-organic water-clarifying agents, such as alum.
- There are no toxic by-products associated with the use of Moringa seeds as a coagulant.
Moringa Seeds

- Seed pods grow green (and can be eaten)
- Pods become brown and hard as they age
- Pods are filled with white pulp
- Seeds are brown, and the kernels are white
Seeds: Coagulant

- Seed kernels are crushed with pestle & mortar
- Seed powder is sown into sack cloths
- Sacks are tossed into jugs at water collection site
- Agitation by transportation disperses the cations to start the coagulation
- Water settles at the home
- Lucid water can be poured from the top of the container
To Treat 20 Liters of Water:

- 2 grams (2 spoonfuls) of fine Moringa powder
- Add 1 cup of water
- Shake for 5 minutes
- Strain through a clean cloth into bucket of untreated water
- Stir rapidly for 2 minutes
- Stir slowly for 10 minutes
- Settle for 1 hour
Moringa Water Treatment Guide

- Somewhat turbid water
  - 1 Moringa Kernel = 2 L Treated Water

- Very turbid water
  - 1 Moringa Kernel = 1 Liter Treated Water
On the Market: Moringa Seed Cake

- A natural coagulant used as a replacement for proprietary coagulants to treat both drinking water and waste water
- Don’t eat this cake!
Untreated vs Moringa Treated Water

- Which would you rather drink?
Moringa in Tanzania

- Combined efforts from Tanzania, Kenya and Switzerland have Moringa Plantations to produce “press cakes” for water treatment
So...

How does it work?
Moringa’s Mechanism

- Moringa $\rightarrow$ Flo polypeptide

- Antimicrobial peptides (AMP)
  - Cationic – overall net positive
  - Amphiphilic (go into the cells)
  - Target Disinfectant
    - Bactericidal
    - Fungicidal
    - Tumoricidal
AMP Mechanisms

- Leakage of cellular material
  - Transmembrane channel
  - Depolarization of bacterial membranes
  - Scrambling of lipid distribution
  - Damage intracellular targets
Moringa Treatment

- Electrostatic flocculation (accelerated by stirring)
- Bacteria attach to colloids
- Flocs condense contaminants
One Mature M. oleifera Tree...

- Produces 5,500 seeds / year
- Treats 7,000 liters of water
- Seeds are 40% oil by weight
- Total seed weight = ~0.32g
- Kernel weight = ~0.22g
Music – Agua de Moringa

- Such an inspiring plant – somebody must sing of its fame! Coagulant
Resources

- Mark E Olson - *Moringa Home Page*
- ECHO – Educational Concerns for Hunger Organization
- Moringa News
- The Miracle Tree – Church World Services (1999)
- LokVani-LokVani, Usha Palaniswamy Ph.D., M.Ed. – Purslane Drumsticks (2005)
- Trees for Life – *Moringa Tree Project*
- Drumstick India – Exports (2005)
- Raveendra Babu and Malay Chaudhuri, “*Home water treatment by direct filtration with natural coagulant*” (2005)
- John Sutherland, “*M.oleifera in water treatment*”
- “Purification of turbid surface water by plants in Ethiopia” Eggert Goettsch (1992)