



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



- Semi-Arid
- Hot
- No Frost



Currently Cultivated In

- tropical Africa
- tropical America
- Sri Lanka
- India
- Mexico
- Malaysia
- the Philippines



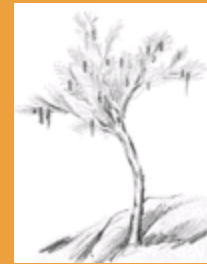
13 Moringa Species



- 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. hildebrandtii* – Madagascar only



Species



- African Horn Specific Species

- *M. pygmaea*
- *M. longtituba*
- *M. ruspoliana*
- *M. rivae*
- *M. boriziana*
- *M. stenopetala* (widely cultivated)
- *M. arborea*



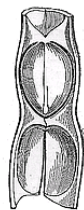
Moringa oleifera
Most Effective



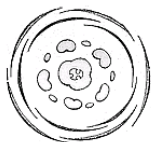
Botanical Details



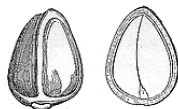
Moringa.
Flower (mag.).



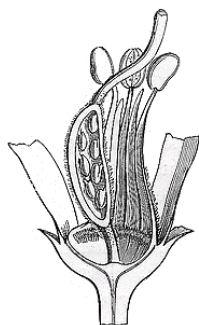
Moringa.
Part of fruit cut vertically.



Moringa.
Diagram.



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



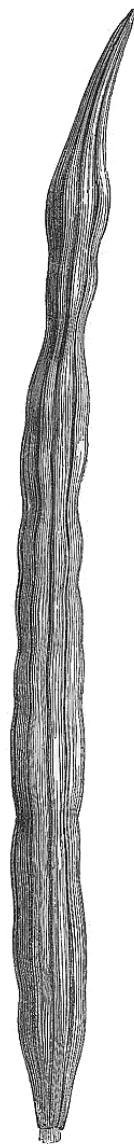
Moringa.
Flower cut vertically (mag.).



Moringa.
Ovule (mag.).



Moringa.
Flower-bud (mag.).



Moringa.
Fruit.



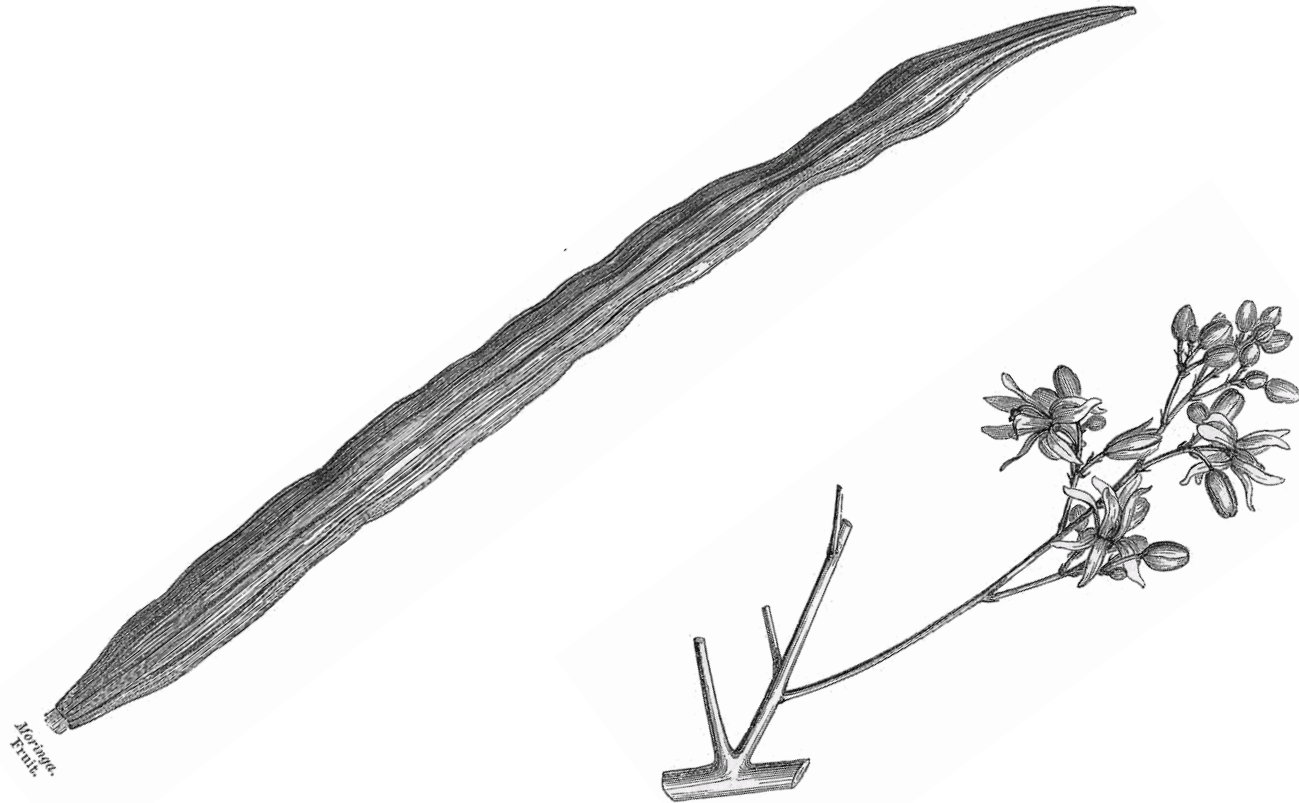
Moringa.
Embryo cut vertically (mag.).



Moringa.
Anther (mag.).



Botanical Details



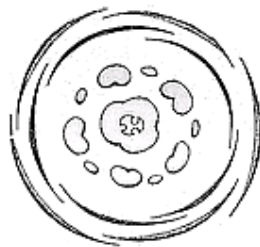
Botanical Details



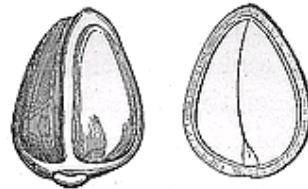
Moringa.
Embryo cut vertically (mag.).



Moringa.
Anther (mag.).



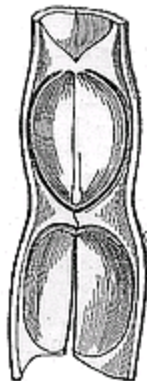
Moringa.
Diagram.



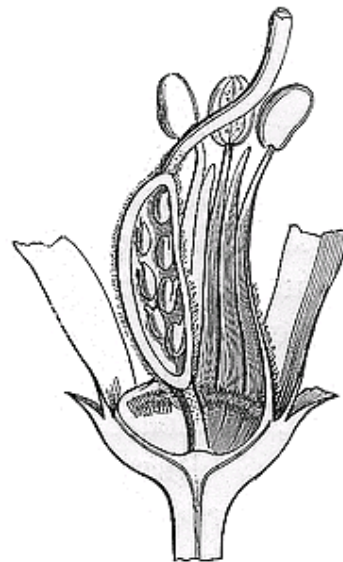
Moringa.
Seed, entire and cut vertically (mag.).



Moringa.
Flower (mag.).



Moringa.
Part of fruit cut vertically.



Moringa.
Flower cut vertically (mag.).



Moringa.
Ovule (mag.).



Moringa.
Flower-bud (mag.).



- 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.

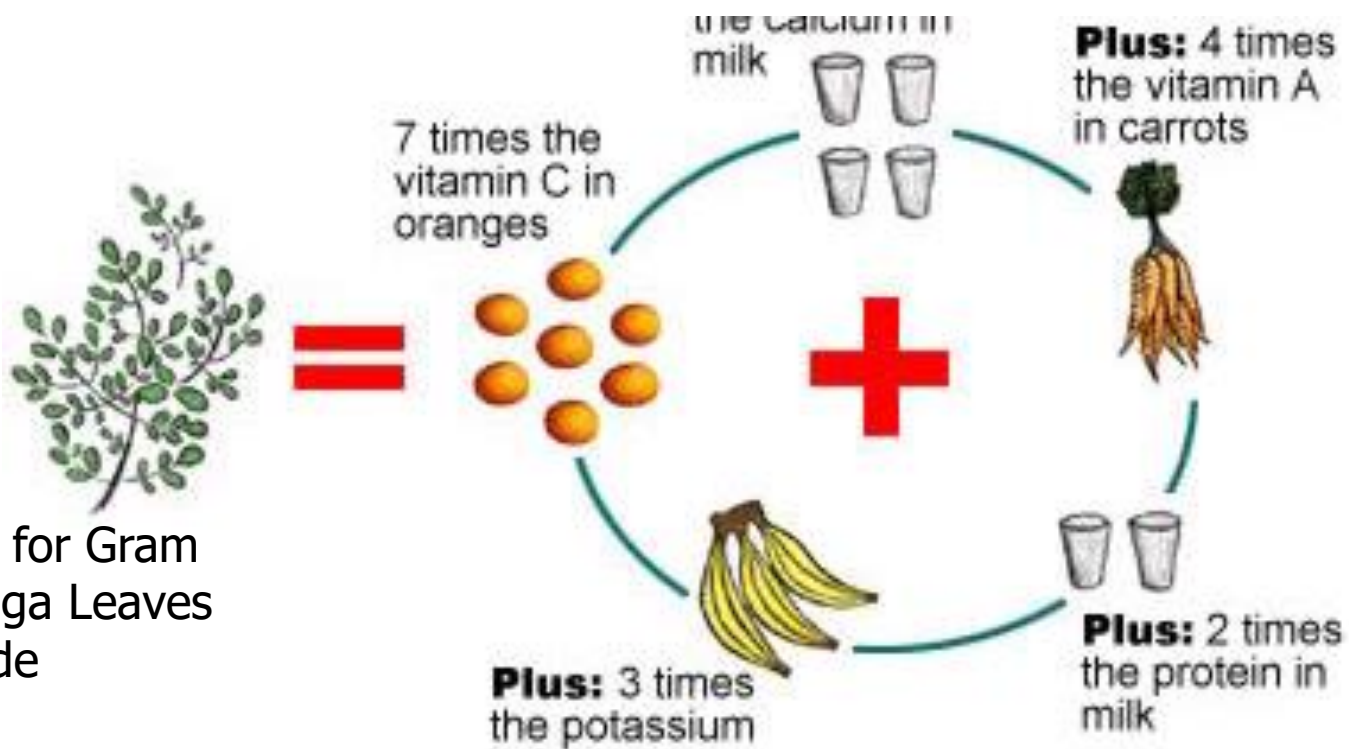
Nutrient	Moringa	Other Foods
Vitamin A	6780 mcg	Carrots: 1890 mcg
Vitamin C	220 mg	Oranges: 30 mg
Calcium	440 mg	Cow's milk: 120 mg
Potassium	259 mg	Bananas: 88 mg
Protein	6.7 gm	Cow's milk: 3.2 gm

As you can see, the Moringa tree is a powerful source of vitamins.





Leaves: Nutritional Supplement



Gram for Gram
Moringa Leaves
Provide



edible Moringa





What does this
have to do with
water treatment?

*Now for what you have
been waiting for...*



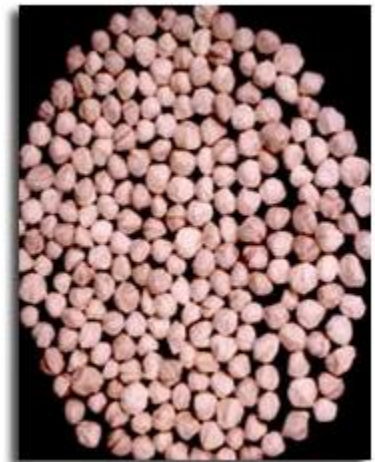
Seeds: Coagulant

- 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
- Do not eat this cake!



- 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





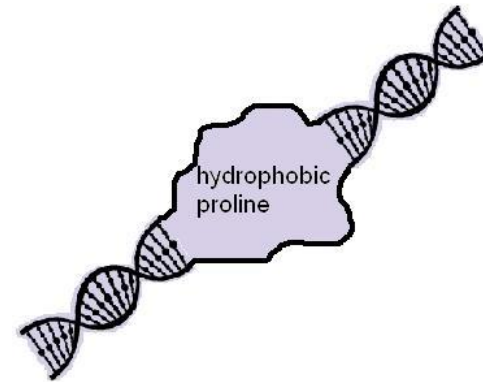
So...

How
does it
work?



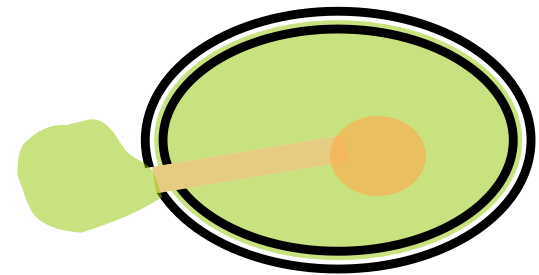
Moringa's Mechanism

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

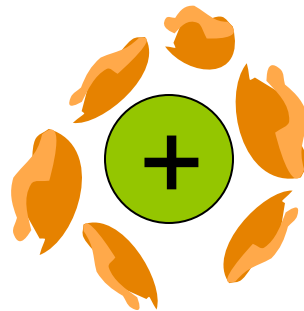


Mechanisms

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



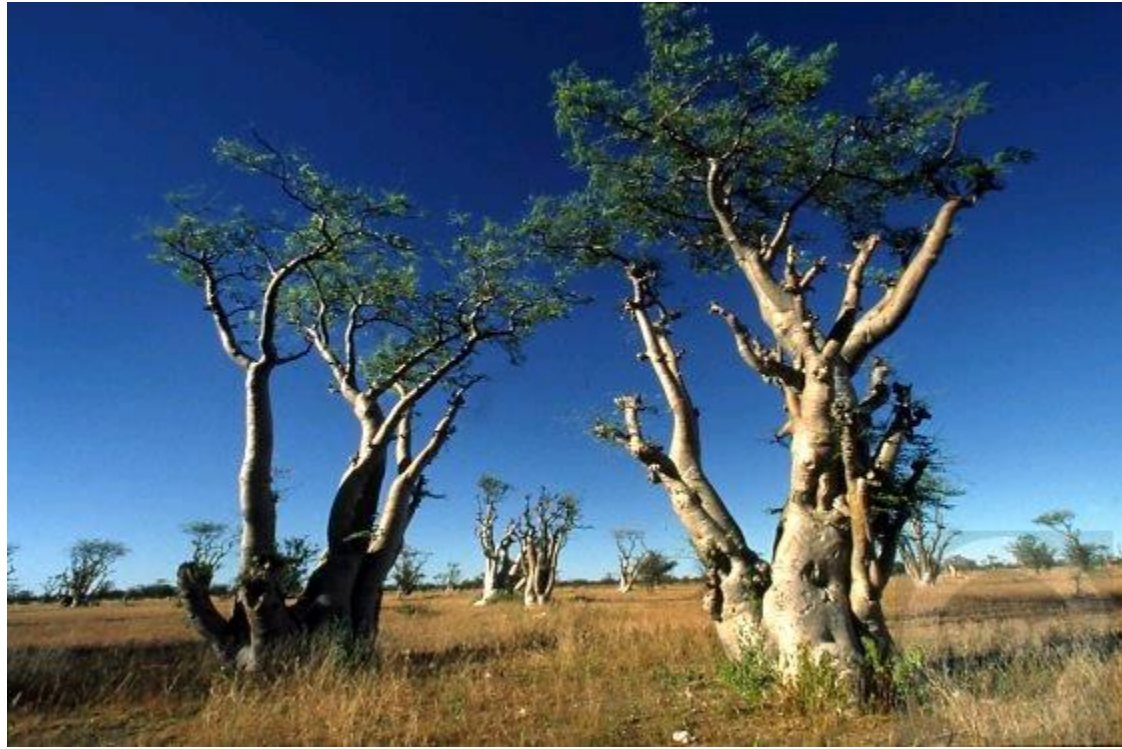
- Electrostatic flocculation (accelerated by stirring)
- Bacteria attach to colloids
- Flocs condense contaminants



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 = $\sim 0.32\text{g}$
- Kernel weight = $\sim 0.22\text{g}$





Music – *Agua de Moringa*

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



Resources

- Kebraab Ghebremichael – Moringa Seed and Pumice as Alternative Natural Material for Drinking Water Treatment (2004)
- Markus Schneider “Drinking water treatment in Tanzania using purified seed extracts from the pan-tropical tree Moringa oleifera” (2006)
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- “Purification of turbid surface water by plants in Ethiopia” Eggert Goettsch (1992)
- Suarez, M., M. Haenni, etc. “Structure-Function Characterization of Optimization of a Plant-Derived Antibacterial Peptide.” (2005)

