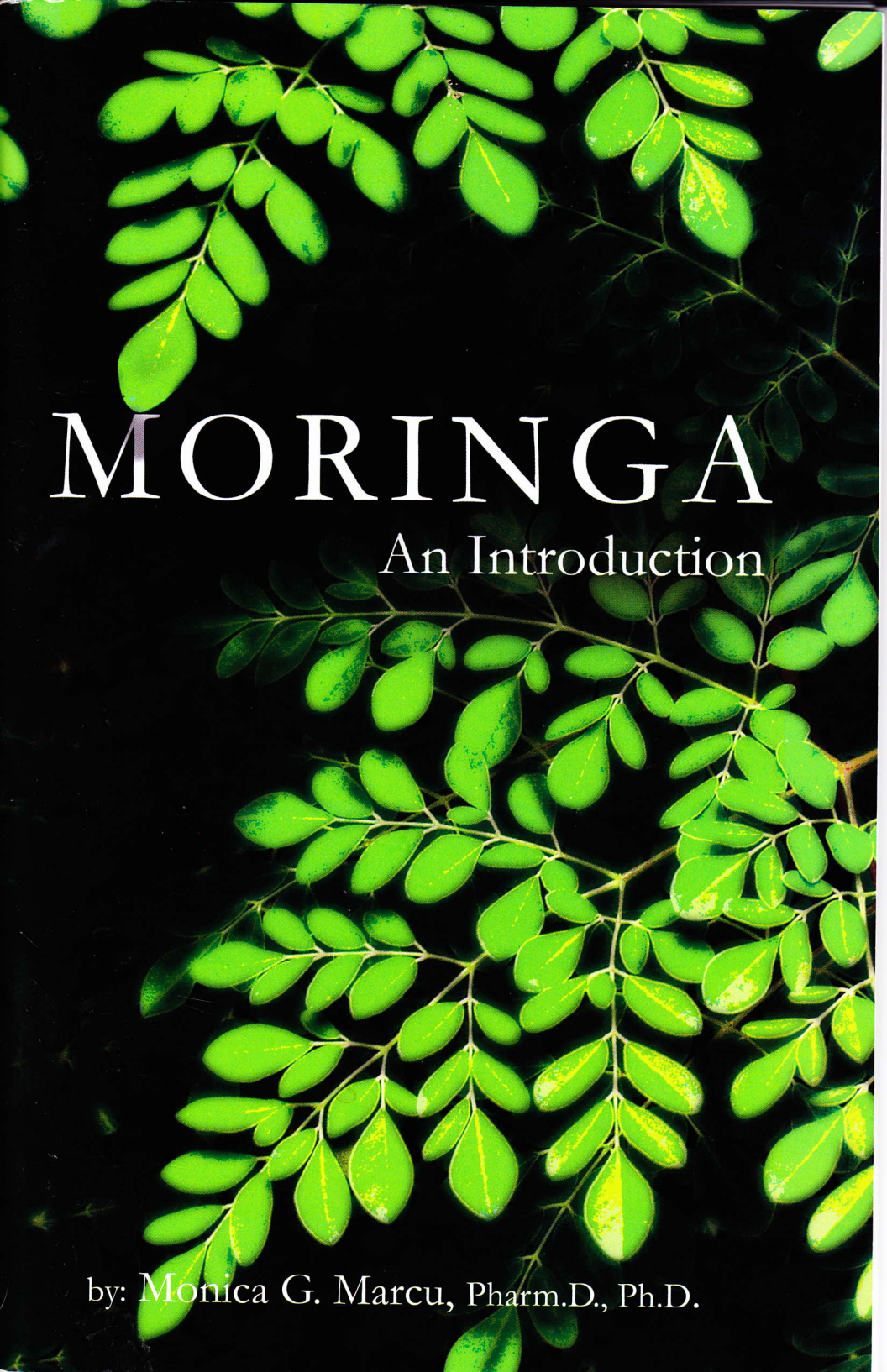
MORINGA
An Introduction
by: Monica G. Marcu, Pharm.D., Ph.D.

Dedicated to all my beloved trees and tree-loving people around the world.

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FOREWORD

I love trees. As a child, I was inspired by my father, who worked for the forestry department, to seek their company whenever I needed peace. As a pharmacologist I studied plants in search of medicines, then I rediscovered them with my lenses and photographed them thousands of times. I could not stop at researching plants in the lab, inside plastic tubes. I knew a better understanding is to be gained where plants live, outside, in their natural habitat. With the hope of taking nature back home with me I photographed forests and fields, meadows and hills. Trees have never been enough for me. Exploring plants and using them for maintaining health are some of my most enduring achievements. I found in plants more than peace. I found wonders, nourishing meals, miraculous skin care, greatest strength and most compassionate healers. All we need to do is recognize the gifts from plants and accept them with humility and gratitude.

"If you will look over the wise, and the great and the useful you will find them down close to the ground." – Luther Burbank

With humility and gratitude I write this book about one of the most intriguing, miraculous trees, Moringa. This plant, extremely rich in vital nutrients, has wisely chosen to grow where it is most needed – in arid, famine-plagued areas of the world. It can amazingly grow 5-6 meters (yards) in a year, despite minimum rainfall. *Moringa oleifera* (Moringaceae) is the most studied of 13 species of Moringa trees, natives of Arabia and India. Today Moringa is common all over the tropics, from South Asia to West and East Africa, in South and Central America. Historically, there is evidence that cultivation of Moringa in India dates back thousands of years, and the traditional medicine used this tree to heal or prevent hundreds of diseases! Closer to our times, scientific evidence has accumulated to endorse many of the medicinal properties of Moringa, since some of its substances were isolated and researched. Due to its numerous healing, nutritious properties and versatility, Moringa is wrapped around the world in legend and respect, as suggested by affectionate names such as "Miracle

Tree," "Mother's Best Friend," "Never Die," "Heals All," "Angel Plant," and "Eat and Drink," to name a few. It has been overwhelming to learn about the many faces of Moringa, so don't be surprised to observe my affection while reading about this great being here.

After a short introduction, this book is organized in chapters explaining the main beneficial nutrients and compounds found in Moringa, some of the most recent scientific discoveries, and how this plant can improve our general health. My wish is that anybody reading this book understands at least in part the extraordinary value of this plant for humanity. The mission was difficult; Moringa has hundreds of substances such as vitamins, enzymes, amino acids, fats, minerals and specific phytochemicals (plant-derived), each with clear importance and numerous applications in healing and nutrition. In comparable amounts (gram per gram), Moringa leaves contains about seven times more vitamin C than oranges, four times more vitamin A than carrots, and four times the calcium found in milk. Combine these with significant amounts of proteins and seed oil, a great taste, and the presence of beneficial antioxidant (anti-aging) and anti-inflammatory substances and you will come to understand why they call it a Miracle Tree. Amazingly, this plant is used not only for nutrition (highly digestible, complete protein, large amounts of vitamins), but also for water purification, biomass, animal forage, biopesticides, tannin, cleaning agents, gum and dye production, fertilizer, foliar nutrient, while the seed oil (non-drying, resisting rancidity) is used in cosmetics, lubricants and has recently been considered as a potential biodiesel!

Moringa is just one of the many offerings of nature for us…

INTRODUCING MORINGA

I would like to warmly introduce to you *Moringa oleifera*, the most studied of 13 species of Moringa trees. *Moringa o.* is a fast-growing shrub or slender tree that can reach 12 m (36 ft.) in height at maturity and can live for up to 20 years. A short but intense life, —it is one of the fastest-growing trees as it can reach 3 m (9 ft.) in just 10 months after it is planted. Moringa is a "compassionate" ideal tree for agro-forestry since its branches can be easily trimmed to regulate shade, and the open crown allows the sunlight to reach the garden vegetables below. Moringa produces beautiful cream-colored, sweet-smelling flowers, great for teas or as a honey source. The pods (triangular, 30 to 50 cm long) host the black, winged seeds. Of all the Moringa parts, the bark is the only one that can be toxic for human consumption and it should be avoided. The other parts (green or dried leaves, buds, pods, seeds and seed oil, flowers) are edible raw or cooked, and are packed with exceptionally valuable nutrients for humans and animals. Around the world, Moringa is getting better and better known for its many attributes and uses, wide adaptability and ease of growth. The number of scientific studies and publications is growing at a fast pace, while anecdotal evidence about Moringa's health benefits are abounding.

Moringa is probably native from the South of the Himalayan Mountains but today is found all over the tropics, from South Asia to West Africa, and in South and Central America and… everywhere indoors. Some farms in the southern United States have also started to cultivate it. Moringa does best where the temperature ranges from 25 to 40 degrees C (77 to 104 degrees F) and annual rainfall is at least 500 mm. It grows well from sea level to 1,000 m (3,000 ft.) elevation. Historically, there is evidence that cultivation of Moringa in India dates back thousands of years, while the Greek, Roman and Egyptian people also used parts of the plant for food and cosmetics.

Recent discoveries have identified Moringa oil as a main component used for the preservation of ancient Egyptian mummies. Indeed, the oil has some wonderful properties, as we shall see further.

Profession and Qualities

Moringa is a healer, food magician, beauty and beautician, a plant with surprising water purification capabilities, a best friend and humanitarian who works for so little. She (I see Moringa as a leafy lady) is one of the most useful trees on earth, especially in drought-prone areas where her succulent, protein-rich leaves can be harvested daily for soups or salads, thus enriching the diet. Of all the parts of the tree the leaves are used the most. The amazing thing about the leaves is that they grow during the dry season, precisely when most other plant growth is limited! The leaves and seeds (pods) are high in vitamins A, C, and B1, beneficial oils (similar to olive oil), and micronutrients. Where local diets lack these essential nutrients, Moringa makes a major contribution to human and animal health; in many cases, it can mean the difference between life and death. No negative effects to daily consumption of Moringa leaves and seeds have been reported so far. Leaves are harvested after plants grow 1 to 2 meters, which usually takes up to 6 months. They are harvested by cutting the entire branches 20 to 40 cm above the ground, and they can be used fresh or dried. Older leaves are more suited to produce dried leaf powder.

Flowers and pods are produced usually during the second year of growth. The pods are harvested when young and tender. Moringa seeds contain about 35% oil that can be used for cooking, cosmetics and lubricants. Since it does not turn rancid, it is excellent in salads, and burns without smoke. The seeds have an extraordinary property: they can be used to purify dirty, bacteria-laced water. They are pounded into small pieces, wrapped in a cloth and agitated with the water in containers. These miraculous seeds act as a flocculent, removing impurities, suspended bacteria, and other harmful organisms or particles out of the solution, leaving drinkable water above. Recent scientific research has shown that these seeds contain powerful antibiotics as well as natural detergent-like substances that also contribute to the disinfection of water. From this perspective, Moringa seeds are considered to be better than the commonly used water purifier, aluminum sulfate, which is slightly toxic. Moringa is readily available where it is needed most—in regions where clean water is a permanent concern—and it represents an economical, viable solution to water purification. Since water-related diseases account for more than 80% of the world's sicknesses, the lack of drinkable water is one of the world's most serious health threats. As a healing plant, Moringa is even more amazing. There is

mounting evidence from around the world, from various traditions and cultures that have used the "Miracle Tree" for so many ailments and troubles. To mention just a few:

• The leaves seem to have a stabilizing effect on blood pressure and glucose levels. They are also used to treat anxiety, diarrhea and inflammation of the colon, skin infections, scurvy, intestinal parasites, and many other conditions.

• The seeds are used against fevers and tumors, while the seed oil is applied externally to relieve pain and swelling from gout or rheumatism. It is used internally for prostate and bladder ailments. The oil is considered an excellent tonic—no wonder, as it contains a multitude of vitamins and beneficial substances, as we shall further discuss.

Recently Moringa was used in combating malnourishment in children, with documented outstanding results. Even more, since Moringa boosts the immune system and provides a multitude of nutrients, it can be used as a complementary medicine in chronically ill patients, including those suffering from AIDS and HIV-related states.

It might sound too good to be true, but many of the traditional remedies are supported by recent scientific studies, and the interest in Moringa's treasures is growing very fast. The secret might be in the multitude of nutrients, antioxidants, anti-inflammatory and anti-aging compounds present in various parts of this tree. Combined, they provide missing nutrients and balance the health, fight parasites and infections, support the natural immunity and fortify the body against stress and environmental harms. The "Never Die" tree does deserve her glory!

In the following chapters, some of the amazing healing and nutritive properties of Moringa will be explored in more details. Since my previous book, "Miracle Tree" (2005), new scientific discoveries have enriched our knowledge of Moringa and gave us new possibilities to employ her for the benefit of the humanity. What proved to be the food and medicine of many people from less fortunate lands deserves now the attention and respect everywhere in the world. While the developed world benefits from plenty of food (too high caloric intake, numerous overweight and obese people), many are actually undernourished since the diets are often deficient in vital nutrients and anti-aging (specifically plant-derived) substances.

Moringa could be the low-caloric, low-salt, nutritious and concentrated solution, with a great taste!

MORINGA IN THE NEWS

Moringa is now more famous than ever in many parts of the world, and that fame is igniting exciting research projects in agriculture, forestry, botany, food and drug industries, health and cosmetics. Churches, charities, peace corps, and other humanitarian organizations—such as Educational Concerns for Hunger Organization, or ECHO, and Trees for Life, an organization that plants food-bearing trees in developing countries—are interested in Moringa for obvious reasons. Church World Service (the U.S. National Council of Churches' global service and witness ministry) has organized international conferences on the Moringa tree as an indigenous resource for fighting hunger and malnutrition. Participants from over 30 countries—including twelve African nations—representatives from private industry, ministry officials, researchers, secular and ecumenical non-governmental organizations were counted among the attendees.

The second Global Summit on HIV/AIDS, Traditional Medicine & Indigenous knowledge in 2008 encouraged the use of Moringa in the treatment and support of HIV/AIDS, due to the "unique properties, as being a major, available, inexpensive source of all essential nutrients." Clinical studies in this group of patients are now organized but they take time to accomplish and be published. Meanwhile, the anecdotal evidence accumulated is rich; based on it Moringa can be used as a method of expanding care to underserved populations in various countries.

There are now many organizations and networks dedicated to Moringa knowledge and use, with thousands of registered members around the world. In some countries, like Ghana, Burkina Faso, Kenya, Ethiopia, and Uganda, National Moringa Associations have been created. The International Eye Foundation (based in Maryland USA) and

Helen Keller International were promoting Moringa for the prevention of childhood blindness due to malnutrition. Indeed, Moringa, through her richness in vitamins, saves precious eyesight in the most vulnerable victims: children with nutrient deficiency.

In April 2008, the USA National Institutes of Health (NIH), which is one of the most respected scientific institutions in the world, celebrated Earth Day with exhibits, posters, programs dedicated to Moringa. The NIH Record publication mentions: **"perhaps like no other single species this plant has the potential to help reverse multiple major environmental problems and provide for many unmet human needs."**

Newspapers and scientific journals mention Moringa more and more often. Until recently, this tree wasn't really known in the West, except to botanists. Today, Moringa, the very plant that desperate mothers from tropical countries used to save their malnourished children, is also featured as the exciting ingredient of fancy skin-rejuvenating creams. The National Science Foundation and National Geographic Society, together with other organizations, have financed scientific studies and collection of all Moringa species to gather more information about this plant. Other prominent organizations that promote or study Moringa include: International Moringa Network, GIANT—Global Initiative for AIDS Nutritional Therapy, Optima of Africa, Peace Corps, and AGADA—Alternative Action for African Development.

Among all the good news, the most moving stories came from the Senegalese project "Mother and Child Health." In an effort to combat child death and disease due to malnourishment, the use of locally grown Moringa was proposed to infants, their nursing mothers and pregnant women. Although Moringa grows in Africa, her leaves were rarely used as food before. In the classical approach to treat malnourished children, expensive industrial products such as whole milk powder, vegetable oil, or sugar were proposed. Most people could not afford them, but Moringa was local and easily grown. The medical staff advised parents to put a little bit of leaf powder in the child's food every day. Children were weighed before and after two to three months supplement use. Many survived only on Moringa leaves or seed powder! Pictures were taken to document the results. When the women brought back their children a few months later, they were hardly recognizable! Malnourished mothers who did not produce enough milk for their babies also recovered beyond all expectations on a Moringa diet. More and more villages started to grow Moringa, and they spread the word.

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I cannot think of another comparable plant with such versatility and richness. Corn, another example of an extraordinarily beneficial plant, has a multitude of uses as well (for oil, cereal, sugar, alcohol, flour, animal fodder, and others), but it does not grow as fast or in poor weather conditions, and it is not known to contain such a wide gamut of vitamins, nutrients or medicinal compounds as Moringa. Are you impressed? You should be.

…We respect and honor and admire you, O trees, for you represent both Peace and Power—though you are mighty you hurt no creature. Though you sustain us with your breath, you will give up your life to house and warm and teach us. We give thanks for your blessing upon our lives and upon our lands. May you fare well in this chosen place. – Druid Ceremony for Planting a Grove

MORINGA, THE MEDICINAL PLANT

As I mentioned when introducing Moringa, it was used around the world by many cultures for a variety of ailments for thousands of years. It is time now to explore and explain in more detail some of the less known facts about the medicinal properties, active compounds, and their effects on humans and animals. Let me start with a short introduction on medicinal plants and their importance for human health. Herbal (plant) medicine is the most ancient form of healthcare known to humankind. Plants as medicines are mentioned in historic documents dating back many thousands of years. Furthermore, many cultures with no written languages, like Amazonian Indian tribes, depended on oral communication to convey information and traditions which were also rich in plant stories. Since prehistoric times and continuing to our modern days, people from all over the world have grown or collected plants for the prevention and treatment of diseases. *Moringa oleifera* is one of the best examples. The World Health Organization (WHO) estimates that nearly 80% of the world population is dependent on traditional medicine for primary healthcare. This is due to the fact that, in many places, plants are the only available, trusted medicine or the only affordable solution. As a result, plants continue to save millions of lives every year. Of the many plants used around the world, some have been carefully studied and used for the production of valuable drugs that can be found in pharmacies. Remarkably, of the hundreds of plant-derived pharmaceutical medicines, about 75% are used in modern medicine in ways correlating directly with their traditional uses by various native cultures! In other words, modern science has validated most of the traditional therapies involving plants. This remains valid for Moringa's precious medicinal properties, as we shall further explore.

How is Moringa Working?

Plants produce and contain thousands of chemical compounds that benefit the plant itself. They protect the plant from herbivores or damaging ultraviolet light, attract pollinators, or prevent competitive germination. Moringa contains a long list of nutrients and pharmacologically active substances such as natural antibiotics (fight bacteria, viruses, fungi), nitrogen-containing chemicals such as moringinine (which increases heart and blood vessel tonus), antioxidants, and anti-aging compounds (please refer to the chapter "Antioxidants in Moringa" on p. 53) which reduce the cellular damage inflicted by normal metabolism. Various other compounds such as enzymes, growth hormones, minerals are also present in Moringa. Most plant antioxidants are also anti-inflammatory and cancer-preventive, thus delaying degenerative diseases (age-related ailments) and aging of tissues. Examples of antioxidants are the compounds called flavonoids (color pigments found in many plants). To date, Moringa is known to contain a number of powerful antioxidant flavonoids such as quercetin and kaempferol. Moringa also contains vitamins A (as beta-carotene), C and E, which qualify as potent antioxidants as well.

Dietary plants are the main source of antioxidant, anti-aging substances for humans!

• **Vitamins** are complex substances vitally important for metabolic and many other physiological reactions. Some of the vitamins (specifically, vitamins A, C, and E) are also potent antioxidants. Vitamins may be considered nutrients but they are also viewed as "medicines" when they bring the health back into balance, normalizing and regulating the abnormal biologic processes that lead to diseases. Moringa is a powerful vitamin factory; some of those present in the various parts of the plant include vitamin C, beta-carotene (a precursor of vitamin A), vitamin E, vitamin K, and many of the B-complex group of vitamins. These are reviewed extensively in the chapter "Moringa, the Nutritive Plant".

• **Antibiotics include** antimicrobial, antiviral and antihelmintic (i.e., against parasites, worms) substances. Some of the most powerful antibiotics have been isolated from plants, but plants can also be used in their whole form to fight infections and parasite infestations. This extraordinary effect of plants is especially important whenever the local population cannot afford expensive medicines from pharmacies. Moringa has long been known to have powerful antibiotic effects and was used by various populations around the globe against infections. Modern science has confirmed and described pterygospermin, with excellent antimicrobial and fungicidal properties. But that may not be all; Moringa seeds and leaves might contain antibiotic substances that are yet to be discovered.

• **Natural hormones, enzymes, minerals, and various phytochemicals** (plant-derived substances) with numerous pharmacological activities in animals and humans. These are too numerous to mention, and it goes beyond the purpose of this book to talk about their specific effects on health. Suffice it to say that plants, generally, are an inexhaustible, fantastically useful and creative source of beneficial substances that can be used in many ways to improve human and animal lives, at all levels. Niaziminin, another Moringa phytochemical, was shown to have potent anticancer activity in animal studies. Interestingly, long before research validated the idea, people traditionally have used Moringa against abdominal and other tumors. Hypotensive (lower blood pressure) compounds niazinin, niazimicin, and niaziminin A and B were also obtained from fresh leaves. These compounds belong to the family of mustard-oil glycosides (very rare in nature).

Moringa is so rich in beneficial substances, hence her numerous pharmacological and nutritive activities. Her leaves are used for stabilizing blood pressure and blood sugar, plus reducing high levels of cholesterol in the blood. The pods and root are used to treat inflammations of the joints, the seeds have antispasmodic properties, the bark can be chewed to stimulate digestion, the flowers can heal various inflammations, and so on. For a short summary of traditional, medicinal applications of Moringa, see Table 1.

IMPORTANT: More often than not, it is impossible to point to a single, specific pharmacological effect of any particular phytochemical from a plant. Whole plants or their parts include a wide variety of active compounds that may act synergistically (complement and empower each other) or annihilate each other's unpleasant effects. The result of such multiple interactions between plant components, on one hand, and plant components and animal organisms (cells, tissues, organs) on the other hand, is expectedly complex. Humans and animals have tried various plants and noticed their effects on overall health. These are, after all, time-tested medicines. Had they not helped healing, people would have discarded them and searched for other, more efficient plant medicines. In other words, if various cultures, in separate and distant parts of the world, have continued using Moringa as a medicinal plant, there must be very reliable beneficial effects.

Table 1 explores some of the best described healing properties of Moringa's seeds, leaves, and pods around the globe, from local traditional medicine. These medicinal applications were discovered by people suffering from diseases generally different from those that are common in the developed world. Their main health concerns were various infections and parasites, malnourishment, and skin inflammation.

High cholesterol, heart disease, cancer, and Alzheimer's disease were not on their priority list. But, as already mentioned and to be further explored, Moringa has plenty of healthy surprises for people with a wide variety of habits and problems.

A diet rich in plants such as Moringa can significantly improve human health by:
-Controlling cholesterol levels and blood sugar and helping normal energy balance.
-Offering vitamins and minerals vital for maintaining normal physiology.
-Offering powerful anti-aging and anti-inflammatory substances, many with anticancer properties.

Table 1.
The Traditional Medicinal Uses of Some of Moringa's Parts by Various Cultures (African, Asian, American)

LEAVES	FLOWERS	PODS	SEEDS
general tonic	general tonic		tonic
anti-inflammatory	anti-inflammatory	anti-inflammatory	anti-inflammatory
anti-cancer	anti-cancer	anti-cancer	
diuretic	diuretic		treats bladder problems
antibacterial	antibacterial		antibacterial
antihelmintic[1]	antihelmintic	antihelmintic	
reduce fever	antibiotic		reduce fever
reduce headache			
laxative			laxative
anti-anemic			treat scurvy[2]
increase milk production			
anti-diarrheic			
antihypertensive			
anti-diabetic			
hepatoprotector			
relaxant sedative			

Note: Roots and bark are also used in a variety of ways for healing.
(1) Induce parasite eliminations (kills parasites and their eggs).
(2) A life-threatening disease due to deficiency of vitamin C.

Since my previous book about Moringa, numerous scientific and medical studies have been published. They are welcome proof and support for many of the traditional medicine claims about the miracle tree. Let's review some of the most exciting recent scientific data:

• Bioactive compounds with anti-inflammatory and analgesic (decrease pain pereception) properties have been isolated from the roots of *Moringa oleifera*. These substances act on the immune system, inhibiting inflammatory conditions such as arthritis. The seeds were also demonstrated to reduce fever in animal models.

• New mechanisms of action have been described through which Moringa stimulates production of own hepatoprotective substances. They protect the liver against chemical or drug damage. From this point of view, Moringa was very active and compared well with silymarin, one of the best known hepatoprotective substances.

• Moringa was shown to possess potent antioxidant, hypolipidaemic (decreasing too high levels of lipids in blood) and antiatherosclerotic substances with clear therapeutic potential for the prevention of cardiovascular diseases. Atherosclerosis, or hardening of the arteries, is characterized by the accumulation of particular fats, calcium and other substances in the inner lining of arteries, forming plaques. Severe complications of atherosclerosis include stroke, angina pectoris, and myocardial infarction—leading causes of illness and mortality in many countries. Studies in animals demonstrated that the *Moringa oleifera* leaf extract significantly inhibited the formation of atherosclerotic plaques in the arteries. Moreover, the preventive effects were highly comparable to those of the most effective drugs (the group of statins) used today for these conditions. Based on these results, *Moringa oleifera* may provide a safe and affordable source for the prevention of cardiovascular diseases without any reported toxic effects. This is absolutely outstanding news, since millions of people around the world use statins daily to prevent complications and onset of atherosclerosis.

• Moringa leaf powder was demonstrated to have hypoglycemic effect on diabetic humans and animals; eight grams per day for a period of two weeks has shown marked reduction in the mean plasma glucose levels. Based on these results, Moringa leaf powder was strongly recommended to supplement the daily diet of diabetic patients.

• The leaves and their extract were shown to accelerate wound healing. Indeed, Moringa was used and is very effective as a skin and hair protector against environmental damage and premature aging. Even more exciting, Moringa was shown to prevent skin cancer in various animal models, and the research continues.

It will beggar a doctor to live where orchards thrive. – Spanish proverb

MORINGA, THE NUTRITIVE PLANT

Although nutrition and diet are pervasive buzz words today there is so much information about food and nutrients—some of it contradictory—that the subject leaves many people confused. It is not my wish to add more confusion to an otherwise important subject. Therefore I will explore Moringa's nutrients and benefits, while explaining briefly their role in human physiology.

What could Moringa bring to the Westerners' Table?

Concentrated vitamins, minerals, all necessary protein constituents, beneficial fats, antioxidant, atianging and anti-inflammatory substances, all in a readily absorbable form and easy to digest = an energy food. Tasty, but with very little sugar and salt.

We have seen the extraordinary benefits and nutritional value of Moringa for people living in less fortunate or impoverished areas that are prone to drought. The leaves, seeds and pods can be eaten fresh or dried in a variety of recipes. According to Optima of Africa, Ltd. (optimaworld.com, a group that has been working with this tree in Tanzania), 25 grams (less than an ounce) daily of Moringa leaf powder "will

trying to nourish ourselves with nutrients and vitamins, Moringa can become a unique "super-food" in our arsenal. It is unique because, even in small amounts, it can supply daily a wide gamut of vital nutrients with few calories. It would take really large amounts and many types of foods - and calories - to bring all the nutrients, vitamins and minerals, antioxidants and anti-aging substances we should eat every day. Why not add a concentrated super-food like Moringa? One plant has it all... even great taste!

Table 2
The Main Nutritive Groups and Valuable Dietary Compounds in Moringa

1. Protein constituents or amino acids (the building blocks of proteins). There are 20 amino acids necessary and found in human proteins, of which 9 are essential. All 9 are found in Moringa.
2. Carbohydrates (several of the "good" type, including fibers; about 3-13 % in pods and leaves).
3. Macroelement minerals: calcium, magnesium, potassium, phosphorus, sulfur.
4. Microelement minerals: iron, zinc, copper, manganese.
5. Fats, as vegetable oils: fatty acids, beneficial omega-6 oils and liposoluble vitamins.
6. Vitamins, many of which with antioxidant properties: vitamin C, E, F, K, pro-vitamin A (beta-carotene), complex of vitamins B - B1, B2, B3, choline, others.
7. Chlorophyll, the green pigment of plants (includes magnesium in its molecule).
8. Other plant pigments, some with antioxidant properties: lutein, carotenoids.
9. Plant hormones with anti-aging properties in humans: cytokinins such as zeatin.
10.Plant-specific (phytochemical) antioxidants: quercetin, kaempferol and others.
11. Plant-specific sterols: beta-sitosterol.
And many others beyond the scope of this book.

AMINO ACIDS IN MORINGA

Plants are an important source of proteins, but most plants actually supply the units making up the proteins: the amino acids. As you know, proteins, lipids and carbohydrates are the three basic groups of biochemical substances of which plant and animal organisms are made. Again, amino acids are the building blocks or monomers of the proteins (which are long chains of amino acids linked together).

How Much Protein Do We Need?

Nutrition experts recommend that proteins (or amino acids) should account for 10-15% of the calories in a balanced diet, although requirements for protein are affected by age, health, weight, and other factors. Generally, a normal adult requires approximately 0.36 grams of protein per pound of body weight, or 0.8 grams per kg weight. That makes a total of 50-80 grams daily. Athletes have higher protein requirements, and babies need much more protein per body weight than do adults. Proteins are digested by the gastrointestinal system and then cut into smaller, simpler units (amino acids) that can be absorbed through the walls of the intestines and used by the body. After absorption, the liver and various tissues will make their own, specifically needed proteins. Thousands and thousands of complicated proteins make up the structure of cell walls, and the soluble particles in blood or less soluble structures of bone and skin. Proteins interact with each other and specifically recognize each other in order to perform all of our physiological functions. Life can be seen as a complicated and beautiful "dance of proteins." Since proteins and other nitrogen-containing substances are continuously degraded and rebuilt, they must be replaced by a continuous supply of amino acids from the diet.

Since proteins are cut into the smaller units and re-synthesized afterwards, amino acids are the best material supply for making proteins in animals/ humans. By eating amino acids instead of long chains of proteins (as found in most animal-derived foods), the human body can save energy, time and ...allergies. Many allergies are due to animal proteins. Therefore, by eliminating those proteins from one's diet, many allergies can be treated or controlled efficiently. (Some allergies can also be due to plant proteins.) Since some babies are allergic to animal proteins or even soy proteins, they should be provided with amino acids, which are much smaller molecules, easier to absorb, and do not usually trigger allergies.

There are twenty amino acids present in the human body. Of those, nine are known to be "essential;" they have to be supplied by the diet since the human body cannot synthesize them, as it does with the other 11 amino acids. Few foods are known to contain all essential amino acids—hence, the importance of a complex, rich diet. The nine essential amino acids are: histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan and valine. Histidine is considered essential for children and babies, not for adults. Strict vegetarians should ensure that their diet contains sufficient amounts of all of these amino acids.

Moringa is one of the very few plants that contain all the essential amino acids, although two of them, lysine and tryptophan, are poorly represented in most plants. Moringa's essential amino acids presence and digestibility scores are more than adequate when measured against the standards of the WHO, Food and Agricultural Organization (FAO) and United Nations Organization (UNO) for small children, the most at-risk population group when it comes to proteins in food.

Compared to soybeans, one of the best known and most valuable plant sources of proteins, Moringa's leaves fare very well. The two plants have similar protein quality and quantity. Food scientists once believed that soy proteins were the only plant-based proteins with a quality equal to that of meat, milk and eggs, but now they have added Moringa to this very short list. With all due respect to soy and its fans, I have to remind you that soy might be a wonderful source of proteins but it is not famous for its content of vitamin C, iron, calcium, and other nutrients. Moringa is! Also, many babies are allergic to soy's protein. Sometimes these babies are lactose intolerant as well, so they cannot drink milk or use it as a source of protein. Since there are no reports of any Moringa-triggered allergies, and since it is safely used as a food for numerous healthy and sick children, Moringa can become a principal source of amino acids in baby nutrition, replacing soy!

Another recent concern related to soy is that a large proportion of the soy cultivated in the United States today is genetically modified (GM) but not labeled as such. The European Union, Japan and other countries often reject GM plants or require strict labeling of the foods containing GM products. Soy is present in a large variety of products, from baby food to supplements, in soy protein isolate or flour. Most believe that there is no safe way to identify and differentiate GM soy from non-GM soy in the U.S. or Canada. While the debate about GM plants is understandably very hot, I do not intend to discuss this here. Suffice it to say that GM plants contain foreign proteins, sometimes derived from insects, which may induce allergies and other health problems in some people. GM plants also pose a serious threat for the environment and common plants or agricultural heritage. Their long-term effects on human health have not been studied yet, but GM plants have been highly promoted and sold unlabeled on North American food market shelves. Therefore, to vegetarians and everybody concerned about their plant protein sources, such as soy, Moringa's amino acids should be a first-line supply, together with her other wonderful nutritive qualities! Table 3 compares the essential amino acids composition in Moringa and soy proteins. Don't miss this eye-opening table!

Table 3
Essential Amino Acids Composition in Proteins of Moringa (leaves) and Soy (protein isolate)

Essential Amino Acids	Soy Protein mg/g protein	FAO/WHO 2-5 yr-old Reference Pattern mg/g protein	*Moringa oleifera* Extracted Leaves mg/g protein
Histidine	26	19	31
Isoleucine	49	28	51
Leucine	82	66	98
Lysine	63	58	66
Methionine + Cystine	26	25	21
Phenylalanine + Tyrosine	90	63	105
Threonine	38	34	50
Tryptophan	13	11	21
Valine	50	35	63

(*Moringa oleifera* amino acid values are taken from F. N. Makkar et al.; see references. These values can vary slightly from product to product.)

Dieters, strict vegetarians, and anyone consuming an inadequate number of calories may not ingest adequate amounts of essential amino acids. In the latter cases, the body will break down the proteins in the muscle and use those amino acids to meet the needs of vital organs. In cases of amino acid deficiency, especially in children, certain diseases and stunted growth might occur.

REMEMBER: As with all other nutrients, the amino acids are best absorbed from a complex, naturally-occurring food or plant source.

SUMMARY

Moringa is one of the very few plants that contain all nine essential amino acids, and their presence and digestibility are as good as soy, one of the best protein sources. Soy is often a highly processed product while Moringa is presented in its natural state—not genetically modified or altered by humans.

Moringa's essential amino acids presence and digestibility are better than those required by the standards of WHO, FAO and UNO. Moringa, even in small portions, provides adequate amounts of proteins for everyone, including healthy or medically compromised individuals, children, and seniors.

MINERALS IN MORINGA
MACRO AND MICROELEMENTS

Our bodies contain, in various amounts, about 5% minerals. Over 20 minerals are needed for normal physiology: some in relatively large amounts, known as macroelements—such as calcium, potassium, and phosphorus—and others in small amounts, known as microelements or trace minerals—like iron, copper and zinc. Some believe that we have in our bodies all the minerals of our planet, and they all play a role, although not entirely understood by scientists at this time. Research continues!

For simplification, minerals have two general functions: building tissues and regulating their function. Almost every process in our bodies is regulated at one level or another by minerals. The human body does not produce minerals; they all must be provided by food.

Macroelements in Moringa

Calcium Moringa leaves contain high amounts of calcium, about 500 mg per 100 g of leaves, while the leaf powder can have about five times more calcium per 100 g. The daily recommended dose for an adult is about 1,000 mg, with more needed for pregnant or lactating women. Remember, calcium is consumed and excreted every day. Ideally and importantly, the consumed calcium should equal the amount of calcium excreted. Calcium is a vital mineral for numerous physiological processes, such as building and maintaining healthy bones and teeth, blood clotting, and other various cellular functions, like maintaining normal heart rhythm and the transmission of nerve impulses. Almost all the calcium in the human body is stored in the bones

and teeth, and when calcium is needed in the blood—for instance, if it is missing from the diet for a while—it is released (borrowed) from bones. This can lead to decalcification of bones if extended over long periods of time. Calcium is important for so many body functions, yet most of us associate calcium only with bone health or disease. Let's explore the role of calcium in maintaining strong bones. Bones are living tissues, constantly formed and remodeled. Even in healthy individuals who get enough calcium and physical activity, bone destruction exceeds bone production after the age of 30. Osteoporosis (porous bones) is caused by an imbalance between bone building and bone destruction. More than ten million Americans, mostly menopausal women, have osteoporosis.

How Can We Delay or Prevent Osteoporosis? By eating adequate amounts of calcium and maximizing bone stores during the times when bone is growing fast—especially up to age 30; by exercising regularly, consuming adequate amounts of vitamin K, usually found in green leaves; and getting enough vitamin D. Moringa benefits here in at least two ways: by its high content of calcium and by its good content of vitamin K. But, as we shall see later, Moringa, as a plant, may fight osteoporosis in other ways as well. We can obtain calcium from various food sources including dairy products (with high concentration of absorbable calcium) and dark leafy greens or beans (with varying amounts of absorbable calcium). There is a hot debate over which source is actually better for supplying calcium that can be utilized by the bones and used by the whole body. According to recent research, too much animal protein intake can leach calcium from the bones. As the body digests protein, it releases acids into the bloodstream, which are neutralized by drawing calcium from the bones. The more animal proteins, the more acidity in the body and less calcium fixed in the bones. It is clear now that animal proteins can cause more acidity and calcium leaching from the bones than plant proteins. Plants, or a plant-based diet actually alkalinize the body, while animal proteins acidify the body. These facts might also explain why certain people who consume fewer animal products, including milk and cheese, suffer significantly less osteoporosis than North Americans or Europeans. Good plant sources of calcium, such as Moringa, are better for long-term prevention of calcium loss!

Are there any other reasons for supplying your calcium mostly from plant sources? You bet!

1. Dairy products are high in "bad" saturated fats that increase the risk of heart disease and other illnesses.
2. Many adults, especially Asians, Hispanics, African-Americans, and even children, have lactose intolerance.

3. Galactose (a milk sugar) has been linked with a high incidence of ovarian problems, including cancer.

The following table (Table 4) compares the approximate amounts of calcium in various sources, both of animal and plant origins.

Table 4

Comparison of Various Calcium-rich Food Sources	
Food (100g)	**Calcium (mg)**
Skimmed milk	120
Yogurt, low fat	180
Spinach	130
Cheese	480
Beans	60
Iceberg lettuce	90
Salmon	180
Nuts, seeds	70
Green peas	35
Moringa leaves	440

Magnesium Moringa leaves and pods contain another important macroelement, magnesium. Approximately 25 mg of magnesium can be found per 100 g of leaves or pods, while the leaf powder can contain approximately 370 mg per the same weight. Magnesium is similar to calcium in several ways; 60% is found in the bones and teeth, and the balance is found mostly in the muscles. Magnesium is the second most abundant positively charged element found within the cells, where it plays vital roles in the processing of energy. Magnesium is linked to a substance known as adenosine triphosphate, or ATP, the main "energy molecule" in the body, which activates about 300 different enzymes and enzymatic reactions involved in functions such as genetic material synthesis, energy storage, intracellular mineral transport, muscle contraction, nerve transmission, blood vessel tone, and many others. Magnesium is extremely vital to health because:

- It stimulates gastric motility and intestinal function (it is a laxative).
- It is a relaxing ion for the nervous system and blood vessels; thus it fights stress, irritability, and high blood pressure.

- It is involved in calcium metabolism and bone fixation; therefore magnesium supplementation improves bone mineral density, while low intake has been associated with the development of osteoporosis.

The recommended dietary dose for magnesium is 350 mg per day for men and 280 mg for women. Magnesium is obtained from the diet, but not all sources are equal in terms of bioavailability. How much magnesium is truly absorbed and used by the body? Magnesium derived from metallic sources (such as salts of magnesium present in water or many vitamin pills) is less absorbable, whereas magnesium derived from plant sources is more easily absorbed.

ATTENTION SOFT DRINK LOVERS: The excess phosphate found in soft drinks depletes your magnesium; therefore you need higher amounts than recommended. This is also valid for over-stressed people (hmm...like me and you), athletes, pregnant and lactating women, and diabetics. Long-term magnesium deficiency may manifest as depression, irritability, heart problems, weakness, poor coordination, nausea, vomiting, and tremors.

Sulfur Now this is the Cinderella of all minerals. Sulfur is one of the most important but neglected nutrients, maybe more important than magnesium, iron, sodium, iodine and even many vitamins. Sulfur has incredibly diverse roles; it is part of many proteins, boosts resistance to diseases, regulates blood sugar, and helps detoxify the body. Sulfur is the third most abundant mineral, after calcium and phosphorus, in the body, but researchers have not yet established the exact daily requirement. It is assumed we all get enough sulfur if we eat plenty of proteins or other compounds containing this element—mostly in fresh or uncooked foods. (Most people are sulfur deficient unless they eat fish and raw meat and their vegetables uncooked!) Most of us need about 850 mg of sulfur for basic turnover (daily needs to replace what was used in the body). Moringa offers a good quantity and quality of organic, absorbable sulfur, from 140 mg per 100 g of leaves and pods, to more than 800 mg in 100 g leaf powder, making it an excellent source of sulfur for everyone.

Why is Sulfur so Important? Sulfur is found in every living cell; it is a constituent of the essential amino acids methionine and cysteine, vitamin B1 and biotin (another type of B-vitamin), the powerful antioxidant glutathione and the anticoagulant heparin. Sulfur is found in hormones like insulin, which regulates blood glucose levels. Sulfur is part of the biological "cement" that keeps cells and tissues together, forms skin, hair, nails and the cartilage that pads the joints. Now it aches! We would fall apart without sulfur. Speaking about pain and joints, many are now familiar with

the sulfur-based compound MSM or methylsulfonylmethane, a natural substance present in humans, many animals and certain plants. MSM is 34 percent sulfur. MSM is so important for pain and inflammation relief (in arthritis, back pain, headaches, fibromyalgia and others) that it is now present in various supplements. You can help your body produce this beneficial sulfur-containing substance right there where it is needed. The sulfur from uncooked Moringa can be absorbed and used to synthesize the necessary sulfur-containing substances. Be good to your joints and get your sulfur from organic sources. It could help alleviate those joint pains!

Microelements in Moringa

Last, but not least of the minerals, microelements are called "micro" not because they are of less importance, but because they are needed in smaller amounts than macroelements such as calcium. Moringa contains significant amounts of microelements such as iron, zinc, copper, manganese and selenium. I am sure, as the research on Moringa progresses, more minerals will be discovered in the plant.

Iron Moringa is already famous for her high content of this vital mineral. I don't know if Popeye has yet found out, but Moringa has much more iron than spinach. 100 g of leaves or pods, or 25 g (less than an ounce) of leaf powder could provide all the daily iron needs of an adult, about 10-20 mg. Iron deficiency is a serious problem not only in impoverished regions of the world, but even in the U.S. A recent United States Department of Agriculture (USDA) survey indicated that small children (1-2 years old) and women ages 12-49 do not get enough iron for their physiological needs from their diets! Surprised? Iron is one of those finicky nutrients that like good company in order to be absorbed and stay in your body! While many foods contain iron, it is not easily absorbed unless certain nutrients such as vitamin C and others are present. Iron in animal foods, such as meat, is well absorbed (15-45 %) but is not well absorbed from dairy products or grains (including your breakfast cereals!). Coffee, red wine and black tea also inhibit the absorption of iron from food, while multivitamin/multi-mineral pills do not really help you with iron, either. Remember, I mentioned earlier the importance of ingesting complex foods rather than taking vitamin pills for the best source of nutrients? Since Moringa contains high amounts of vitamin C (please review "Vitamins in Moringa" on p. 34), it represents an excellent source of absorbable iron.

Why is Iron so Important? Iron is a constituent of hemoglobin, the main protein that carries oxygen in the blood to all cells and also forms part of the oxygen-carrying protein myoglobin in the muscles. As you know, our bodies cannot function

without oxygen being transported to all tissues. Iron is also a necessary component of many enzymes, the dynamic proteins involved in all metabolic, digestive, and respiratory processes. Iron is concentrated in storage forms in the body, as ferritin and hemosiderin (15 % of the iron is stored for future needs and mobilized when food intake is inadequate). Women with heavy menstrual periods can lose significant amounts of iron. Too much iron is not good either; consequently the body strives to maintain normal iron levels by controlling the amount of iron absorbed from food. Supplements in the form of soluble iron salts can be dangerous if there is no iron deficiency. Again, the best source of iron is your nutritious food!

Manganese This is another essential trace mineral with multiple functions. Manganese is mostly concentrated in the bones, liver, pancreas and brain. It is a component of several enzymes such as manganese-superoxide dismutase, which prevents tissue damage due to oxidation. Manganese also activates numerous enzymes involved in the digestion and utilization of foods, breakdown of cholesterol, sex hormone production, and the function of bones and skin. The estimated adequate dietary intake for manganese is 2-5 mg for adults. Moringa has 5 mg per 100 g leaves or 50 g leaf powder, and thus qualifies as an outstanding source of manganese. In humans, manganese deficiencies are rare, although some groups of population might have suboptimal levels, including people with osteoporosis and multiple sclerosis. Moringa sources are better than many others considered excellent (providing more than1mg manganese per serving) including pecans, peanuts, oatmeal and bran cereal. Attention: very little manganese is found in meat or fish, dairy products, or sweet and refined foods! Please read food labels! See what you eat and notice how many vital nutrients are missing or are low in processed, cooked foods.

SUMMARY

Moringa has a substantial content of vital macro- and microelements such as calcium, iron and sulfur, all absolutely necessary for good health.

Humans do not produce minerals, therefore, they all must be provided from food.

Moringa leaves contain calcium in quantities similar to cheese, and far higher than most plants.

Moringa leaves are very rich in iron in comparison with spinach and other plants.

HISTOIRE NATURELLE, *Botanique*.

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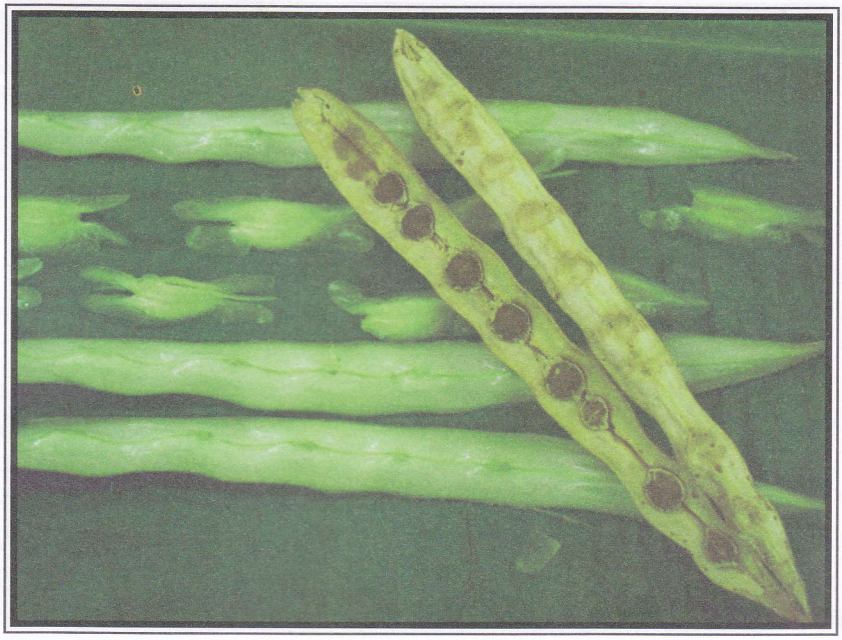
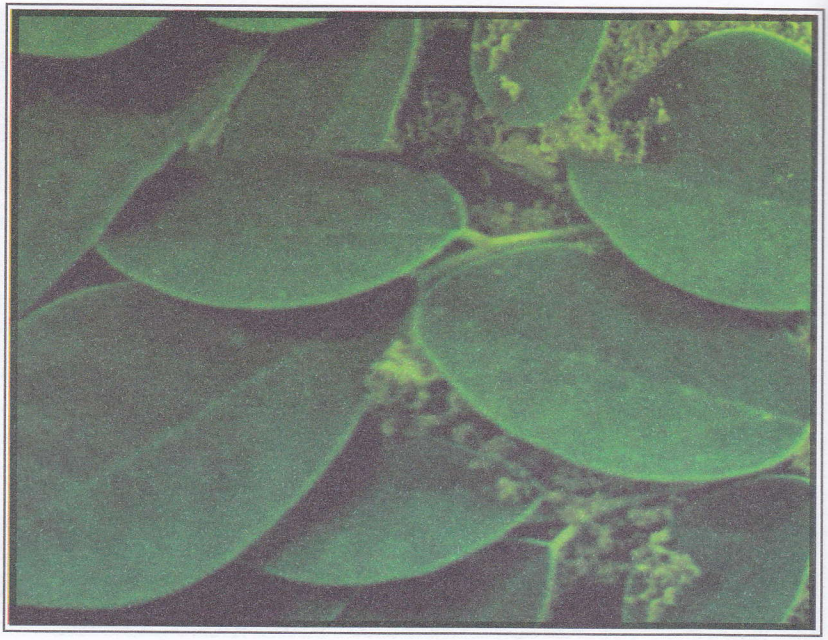


Pods and Seeds

Young Moringa Plantation



FATS IN MORINGA

Moringa seeds contain between 30-42% oil, with 13% saturated fats and 82% unsaturated fatty acids (those considered very beneficial in the diet). The leaves and pods, surprisingly, also contain 1-2% fats. Since Moringa is a food champion and seems to gather all the best nutrients for us, don't be surprised to find out that it also provides some of the Essential Fatty Acids (EFA's), and other "good" fats as oils. As in the case of essential amino acids, the EFA's cannot be naturally synthesized by the human body; therefore they must be obtained from the diet. *Moringa oleifera* (oleifera is the Latin term for "oil-containing") surely deserves her name.

The Good, the Bad and the … Oleic Acid

Don't eat too much fat! A fatty diet is unhealthy, right? WRONG! Fats of the good sort, as we shall further explore, are absolutely vital for health. All cells, especially the membranes surrounding the cells, contain large amounts of fats (including cholesterol), and our brains are composed mostly of fat. Cann't keep a brain without fats! Most of the body's biology—including heart function, blood pressure, fertility, inflammation and immunity resistance to various infections and even cancer—depends on the presence of optimal fats. Damaged cells are replaced with new ones on a daily basis; in this process, fats are absolutely necessary, as they make up a good proportion of the cell membranes. A low-fat diet will make you very ill in the long run; it induces heart problems, stunts growth, and harms the liver, kidneys, endocrine glands (that secrete our hormones) and the immune system. Not all fats are equal, though. While animal sources contain mostly saturated fats (more hydrogen in their chemical structure) or "bad" fats, many plant-derived fats are high in unsaturated, beneficial oils. The more unsaturated a fat is, the more liquid (oily). What about the

amount of fats in the diet? Detailed research has shown that the total amount of fat in the diet (high or low) isn't really linked with disease, but what really matters is the type of fat in the diet. The secret is to substitute good, vegetable fats for bad fats. A particularly harmful group of fats are the man-synthesized hydrogenated (trans) fats that can be found in everything today, such as biscuits and candies, margarines and vegetable shortening, fast foods and in most commercially baked goods.

Saturated fats increase the occurrence of chronic diseases, inflammations, heart problems, strokes, atherosclerosis and others.

Unsaturated fats protect against many diseases, including cancer, nourish the body and fight inflammation, depression and infections.

What About Cholesterol in Food? Although it is important to limit the amount of cholesterol in the diet, dietary cholesterol isn't the main enemy. High cholesterol in the bloodstream may significantly increase the risk for heart disease and strokes. But the cholesterol in the blood is mostly (75 %) made in the liver, while only a quarter is derived from what is absorbed from food. Again, the biggest influence on blood cholesterol level is the ratio and type of fats in the diet. (For more information about cholesterol and why Moringa could help, please review the chapter "Beta-sitosterol in Moringa" on p. 45.)

One of the best types of fats is oleic acid, a monounsaturated oil which is actually present in Moringa in high quantities. About 73% of the Moringa oil is oleic acid, while in most beneficial plant oils, it only contributes up to 40%! For instance, olive oil (one of the best, healthiest types of fats) is about 75% oleic acid, while sunflower is about 20%, and canola about 55% oleic acid. Similar to olive oil, Moringa has only 13% saturated fats.

You must have heard about oleic acid, the main fat in olive oil—one of the best known secrets of the healthy Mediterranean diet, which is linked to lower rates of cardiovascular disease and certain types of cancer. The Mediterranean diet is actually rich in fats, but we are really talking about the good oleic acid. Science has clearly established the link between reduced incidence of cardiovascular disease and olive oil (oleic acid) and it is believed that this is due to its ability to lower cholesterol levels. (High cholesterol levels are a main risk factor for cardiovascular disease.) Risk factors of heart disease, stroke, and high blood pressure are also positively affected by oleic acid. Some scientists have recommended the daily use of olive oil to lower the need for antihypertensive drugs! Oleic acid also reduces atherosclerosis (hardening of the

arteries). European studies have found significantly lower breast cancer incidence among women with a high intake of monounsaturated fats, mainly in the form of olive oil. As of this date, science has yet to study the benefits of Moringa oil, but that day will surely come in the not-too-distant future. However, since Moringa oil is so similar to olive oil, one could expect similar beneficial properties.

Another exciting property of oleic acid is related to its ability to regulate the blood glucose levels. Glucose is the common type of sugar in the blood. Research studies have shown that olive oil can markedly lower blood glucose levels. Even diabetics who switch from a high-carbohydrate/low-fat diet to a high-fat (50% of calories coming from fat) diet, with most of that fat as olive oil, can lower their blood sugar levels so much that they require less insulin injections. Insulin is the pancreatic hormone regulating, among other things, blood glucose levels. Some diabetics do not produce enough insulin anymore, while others have become "insulin-resistant," meaning that their cells do not recognize and do not react anymore to the body's own insulin. Both groups require constant treatment and careful diet habits. Even in the case of insulin resistance, oleic acid may help to prevent or delay the onset of the diabetes by preventing insulin resistance. Many overweight people are candidates for diabetes with insulin resistance. For them and for anybody else, it is worth taking a good look at oleic acid and replacing the saturated fats with plant oils rich in oleic acid.

Similar to olive oil, Moringa oil also contains 1-2 % EFA's such as the omega 3 and omega 6. EFA's favorably affect atherosclerosis, coronary heart disease, inflammatory disease, depression and even behavioral disorders (temper tantrums, learning, and hyperactivity in children).

An inadequacy of essential fatty acids is one of the main, widespread nutritional deficiencies among Americans and, generally, other modern societies consuming a refined or over-processed diet. This is a serious health risk, especially for children, since fatty acids are crucial for proper growth. The brain development of growing fetuses and newborns depends absolutely on the presence of EFA's.

ATTENTION PARENTS OF HYPERACTIVE CHILDREN: Recent studies have shown that hyperactive children have much lower levels of essential fatty acids! Take a look at the labels of the cookies, cereals, peanut butter and other foods; replace foods containing hydrogenated or trans fats, and introduce instead plenty of good, fresh fats: raw nuts, extra virgin olive oil, flax, fish and Moringa!

SUMMARY

Moringa oil fat composition is very similar to that of olive oil, one of the most studied, most beneficial types of fat.

The main (73%) fat in Moringa, oleic acid, is an unsaturated fat linked to reduced incidence of heart disease, atherosclerosis, and various cancers.

Moringa leaves and seeds also contain beneficial essential fatty acids (EFA's).

The type of fat is more important than the amount of fat in the diet.

Strive for unsaturated fats!

VITAMINS IN MORINGA

Moringa is a vitamin treasure. Vitamins C, E, F, K, pro-vitaminA (beta-carotene), and many of the B-complex vitamins—B1, B2, B3 and choline—are found in various parts of Moringa. Vitamins are organic compounds absolutely essential for growth and maintenance of life in plants and animals. They are classified into two groups:

1. Fat-soluble (liposoluble): vitamins A, D, E, K. These may be stored in the body in fat tissues.
2. Water-soluble (hydrosoluble): the B-complex, vitamin C. These are excreted when not needed for use.

Replenishment of these to the body is a critical process. Interestingly, vitamins have the same roles in almost all forms of life, but higher animals (including humans) have lost the capacity to synthesize many of them. Consequently, most vitamins have to be supplied by food. Vitamin deficiency generates serious diseases in all organisms requiring them.

What functions do vitamins perform? Vitamins function in many metabolic reactions. For instance, fat-soluble vitamins act as regulators of specific metabolic reactions, while water-soluble vitamins function as coenzymes (workmates of enzymes which control biochemical reactions and utilization of energy). Important biological functions, such as blood coagulation, vision, growth and development, tissue structuring and connectivity, bone formation and calcium fixation, and many others, depend on the presence of appropriate amounts of vitamins.

There is so much information available about vitamins, often contradictory, that it seems that anyone can be a specialist. Multivitamin pills are in every household

today, although it is safe to say that most people in the Western world probably do not need multivitamins regularly. Of course, a medical prescription is an exception. In addition, many suppliers offer vitamins that are not truly absorbed due to poor formulations. These vitamins are not truly "bioavailable" (absorbable and available for maximum effectiveness to the body). Alternatively, all humans need complex, natural vitamins provided by a nutritious diet consisting mostly of plants (leaves, fruits, seeds, roots, sprouts, legumes, mushrooms, etc.). Remember, nutrients are meant to work in a delicate balance with each other, not as separate compounds, as often formulated in pills, capsules and tablets.

Vitamin C A superstar among stars, vitamin C (ascorbic acid) is one of the best-studied substances supplied by the diet. This water-soluble vitamin is not a coenzyme but rather is required, among others, for the synthesis of collagen, a protein of the connective tissue in vertebrates. It does not sound too important but, in fact, without collagen our bodies would fall apart. One of the main symptoms of scurvy, stemming from lack of vitamin C, is the loss of teeth, but this is just the beginning of a painful, deadly disease. Scurvy is rare today but mild vitamin C deficiency is probably frequent. This is due to the fact that vitamin C is very sensitive and easily lost during cooking and processing of foods. Fresh fruits and greens have bioavailable vitamin C in various amounts. Juicing fruits and vegetables is also a great way of supplying vitamin C.

Since the human body is unable to manufacture vitamin C, we must acquire it from our diets -read PLANTS. Moringa contains abundant amounts of vitamin C. 100 g Moringa leaves contain more than 200 mg vitamin C, while 100 g orange juice has only about 40 mg of vitamin C. As you know, citrus fruits such as oranges and limes are considered to be among the best sources of vitamin C, until Moringa.

Vitamin C is surrounded by some controversy in terms of daily allowance and uses. All this fuss about vitamin C is due to its many other functions besides collagen formation. Some of the functions of vitamin C currently known are listed below:

- Supports and enhances the immune system in many ways; it has antiviral, antibacterial and anticancer properties.
- Supports the function and vitality of blood vessels. Therefore, it is beneficial in various conditions such as coronary disease that affects the heart arteries.
- Has powerful antioxidant capacity and anti-aging properties. Vitamin C combats the oxidation of lipids, which has been linked to degeneration and premature aging, and works inside the cells to protect the genetic material from damage caused by free radicals. (Please review the chapter dedicated to antioxidants on p. 53.)

• Supports detoxification and neutralization of toxins and pollutants by stimulating detoxifying enzymes.

While the recommended dose is only 60 mg of vitamin C per day (and that is found in just an ounce of Moringa leaves!), many argue for much higher needs – at least 2 grams per day. But some claim that so much vitamin C is useless or even dangerous to our health.

Hmm…Who should I believe? Most of the time I personally use my "BEAR method." Since our closest relatives in what concerns the digestive system, are omnivorous animals such as bears and monkeys (primates) who enjoy huge amounts of fresh greens and fruits loaded with vitamin C, daily, we humans could also require huge amounts of vitamin C for proper health. In any case, 1-2 g of vitamin C cannot be dangerous to us; this is probably the amount of vitamin C that our ancestors ate during most of their long development as part of the animal kingdom, when they used to inhabit the wilderness.

There is a wealth of evidence about better health and reduced death rates from heart disease, cancer and other diseases, with 1-2 g of vitamin C per day for an adult. The more greens and fruits, the better. To enhance its antioxidant properties, it is best to supply vitamin C with other antioxidants, especially those found in plants, as there is strong evidence of synergy between various antioxidants. In other words, birds of a feather …work together! Since Moringa is also rich in various other antioxidants, it makes clear sense to consider it as an excellent source of bioavailable and efficient vitamin C.

The B-Complex of Vitamins—to B or not to B Healthy?

The following vitamins are part of a complex group of vital factors for our health. Their deficiency leads to serious diseases. Moringa is an excellent source of vitamins from the B-complex group.

Vitamin B1, also known as thiamin, was the first B-vitamin to be discovered. It is part of a large group of water-soluble vitamins, the B-complex group. Vitamin B1 is vital for the production of energy within every cell and plays an essential role in the metabolism of various sugars (carbohydrates), which are a major source of energy. This vitamin is also needed for the processing of fats and proteins and for the normal function of the nervous system, heart and muscles. For instance, vitamin B1 supports healthy development of the fat-like layer which surrounds most nerves, called the myelin sheath. In the absence of vitamin B1, this layer can degenerate or

become damaged, making nervous transmission problematic. Consequently, some of the symptoms of vitamin B1 deficiency are pain, prickly sensations and nerve deadening.

Interestingly, there is a decline in vitamin B1 levels with age, even in apparently healthy people. Serious deficiencies are not common in the Western world, although alcoholics, smokers, heavy drinkers of coffee and tea, and people with malabsorption conditions (who cannot properly absorb nutrients) or poor eating habits may be deficient in this important vitamin. They might need 5-10 times the ordinary amount of vitamin B1!

Some might wonder what I mean by poor eating habits. Well, vitamin B1 is extremely unstable. From this point of view, poor eating habits that do not supply enough of the vitamin are actually very common. Examples of poor eating habits include:

- Eating mostly cooked, boiled, or processed food such as decorticated grains.
- Eating mostly white flour bakery products instead of whole grains.
- Long-term refrigeration or freezing of foods: after one year, more than 90% of vitamin B1 in greens is lost and many other nutrients are also depleted.

If you think you share these habits (and many do!) you should consider introducing some rich, raw greens and vegetables in your diet. Pills wouldn't really help you as many supplements contain vitamin B1 in a biologically inactive form called thiamin hydrochloride.

The recommended daily allowance for adults and children is 1-2 mg per day. Now, you might think this is a small amount but vitamin B1 is not very abundant in foods, especially in our over-processed foods. As I said, it can easily vanish after cooking. For a list with vitamin B1 sources, see Table 5. Please note that Moringa leaves contain large amounts of vitamin B1 even compared with the best sources already known. The leaf powder is 10 times more concentrated in vitamin B1 than the leaves!

Table 5
Sources of Vitamin B1

Food (100 g)	Vitamin B1 (mg)
Asparagus (boiled)	0.12
Romaine lettuce	0.11
Tuna (broiled)	0.32
Green peas	0.20
Broccoli (raw)	0.03
Black beans (boiled)	0.20
Carrots (raw)	0.06
Corn (boiled)	0.18
Orange	0.11
Red meat (cooked)	0.15
Soy beans (cooked)	0.12
Moringa leaves	**0.21**
Moringa leaf powder	**2.6**

For those concerned about calories, keep in mind that tuna might have more vitamin B1 per weight, but provides many more calories than Moringa. Tuna also does not supply the broad spectrum of nutrients that Moringa provides.
Modern nutrition science has shown that vitamin B1 works hand-in-hand with vitamin B2 and vitamin B3, but Moringa "knew" this from the very beginning. As a wise plant, Moringa has decided to produce the other two vitamins as well, just to make it easier for us!

Vitamin B2 is also known as riboflavin and is another vital factor required for the production of energy, proper use of oxygen, and the metabolism of amino acids, fats and carbohydrates. Riboflavin is needed to activate vitamin B6 and assist the adrenal glands that produce a variety of hormones regulating water and mineral balance. Riboflavin is important for red blood cell formation (these cells transport oxygen to the tissues), antibody production (antibodies protect us against infections), and growth. It is required for healthy mucus membranes, skin, for the absorption of iron and certain vitamins. And the list goes on…

The recommended dietary allowance (RDA) is about 1-1.5 mg per day, but some groups of people, such as athletes, alcoholics, and cancer patients, need more. The use of antibiotics and birth control pills also calls for more vitamin B2. The good thing about this vitamin is that it is much more resistant to cooking, although it is sensitive to light. However, 70% of it is removed from whole wheat (a rich source) during processing of flour. This is another reason to replace white bread with whole-grain bread.

So what is the content of vitamin B2 in Moringa? Moringa leaves compare with broccoli and spinach in B2 content, with about 0.07 mg per 100 g, while leaf powder has 20 mg per 100 g.

Vitamin B3 is the name given to nicotinamide and nicotinic acid. This vitamin is important for producing energy and the metabolism of proteins, fats and carbohydrates. Vitamin B3 also supports the digestive system function and promotes healthy skin and nerves. Moringa leaves and pods contain 0.5-0.8 mg while the leaf powder has more than 8 mg vitamin B3 per 100 g.

Choline is part of several major phospholipids which are critical for normal membrane structure and cellular function. It is also used by the kidneys to maintain water balance and by the liver for synthesis of various compounds. Choline is particularly needed by athletes and people who exercise vigorously and is vital for the developing fetus and the infant. Pregnancy and breast-feeding might deplete maternal stores of choline, therefore these conditions will also require extra choline. Although the body can synthesize part of the choline in case of deficiency, it is recommended that humans intake enough choline from their diet. Moringa leaves contain more than 400 mg choline/100 grams, which is about the daily recommended amount in adults.

LIPID-SOLUBLE VITAMINS IN MORINGA

Vitamin A is a lipid-soluble vitamin of vital importance for vision, skin structure, and immune system functioning, among others. It is believed that this vitamin is the most important vitamin for immune protection against all kinds of infections and possibly cancer. It is the vitamin of healing and without it, any recovery and healing process would be delayed or slowed. It is also known to be involved in bone development. Vitamin A deficiency leads to disorders of the reproductive system, infections, xerophthalmia (a drying condition of the cornea of the eye), blindness, and ultimately death. Vitamin A-related blindness in children was and still is a terrible medical situation in impoverished countries of the world.

Vitamin A is an excellent example to illustrate the power of a natural, balanced diet versus man-made vitamin pills. While vitamin A is essential for health, an excess of it can lead to serious medical problems, but an excess of vitamin A can only be achieved by abusing vitamin A supplements. Since it is a liposoluble vitamin, it can accumulate in the body (liver) and lead to toxicity. (Water-soluble vitamins like vitamin C and the B-complex are eliminated easier when in excess.)

I know that Eskimos are going to contradict me here: one can achieve excess of naturally-occurring vitamin A not only with pills but also by eating polar bear liver! Did you know that you should never eat polar bear liver? The vitamin A found in a modest piece of polar bear liver is more than a two years' supply for a human. But as long as you do not hunt the poor polar bear for your vitamin A supply, you need not worry about an excess of vitamin A from food. But you should worry about having *enough* vitamin A in your food.

Here comes Moringa! Moringa contains extremely rich amounts of vitamin A in its plant form—pro-vitamin A or beta-carotene. Beta –carotene gives carrots their orange color. It is a member of the carotenoid family. Carotenoids are an important group of pigments responsible for many of the yellow or orange colors of fruits and vegetables, as well as the wonderful color of the fall leaves.

Beta-carotene and vitamin A are very closely related in structure. The body produces vitamin A from beta-carotene, and if the beta-carotene is in excessive quantities, it can be eliminated or deposited in the fat tissue; thus no toxicity results from ingesting large amounts. Beta-carotene is a safe source of vitamin A. Interestingly, carotenes from natural sources are absorbed 4 to 10 times better than synthetic carotenes, such as those found in most vitamin pills, tablets or capsules. But even from natural sources, only one-third of the beta-carotene is absorbed and only one-half of what is absorbed is converted to vitamin A. Why is this important? Because you have to search for the best, richest sources of carotene to be sure you obtain enough vitamin A. One of the best sources is Moringa leaves. Moringa leaves contain almost 7-8 mg of beta-carotene, while the leaf powder has twice that amount per 100 g. Your daily needs are about 1 mg but some have suggested more, especially for protection against ultraviolet radiation from excessive exposure to the sun. Natural beta-carotene also guards against heart disease and can keep harmful lipoproteins containing cholesterol from damaging the heart and coronary arteries and prevents certain types of cancers, and stroke.

I am sure you are anxious to know how Moringa's beta-carotene content compares with other plant foods. Besides animal foods, such as whole milk, butter, egg yolk and liver, the best sources of vitamin A as carotene are green leafy vegetables and colorful fruits and roots such as mangoes and carrots. You will be surprised to find that Moringa leaves have more beta-carotene than the carrot, famous precisely for its content of beta-carotene! For a reality check, please consult Table 6.

Table 6
Beta-Carotene Content and Corresponding Vitamin A Equivalents in Various Foods*

Food	Beta-Carotene mg/100g	Vitamin A equivalent mg/100g
Coriander leaves	7,000 - 8,000	1,166 - 1,300
Cabbage	1,300	218
Spinach	3,600	600
Carrot	1,300 - 2,600	215 - 430
Mango (ripe)	3,000	500
Orange	200	35
Pumpkin	650 -700	100 - 120
Moringa leaves	**7,000 - 8,000**	**1,166 - 1,300**

*Animals do not produce beta-carotene

Another important reason to supply plenty of beta-carotene is its powerful antioxidant capacity, a property not related to vitamin A. The chapter "Antioxidants in Moringa" on p. 53 will describe in detail the harmful effects of oxidants and how they can be annihilated by antioxidants found abundantly in plants.

Beta-carotene blocks the action of activated oxygen molecules or "free radicals" that contribute to aging and can damage all cells. Beta-carotene also enhances the activities of natural killer cells (a type of blood cell of the immune system, with protective effects against foreign organisms) and other cells of the immune system that protect the body against infections and cancer. It has been clearly proven that natural beta-carotene may prevent cancers of the epithelial cells that make up the outer layer of skin, mouth, lungs, stomach, intestines, bladder and glands in the breasts. In some

cases it even reverses precancerous conditions! However, beta-carotene in man-made supplements has not demonstrated cancer-protective properties, on contrary!

Vitamin E is also known as tocopherol, and is an essential fat-soluble factor. It has a broad role in promoting health, from enhancing fertility and energy production, to preventing aging, heart disease and cancer. The main benefit of vitamin E is that it is a powerful antioxidant. It protects cells from oxidation by neutralizing unstable free radicals, which cause cell damage. Vitamin E gives up one of its electrons to the electron-deficient free radicals, making them more stable, and thus less dangerous. While vitamin E acts as a donor, it also protects other antioxidants (like vitamin A) from being oxidized, therefore prolonging their effectiveness. This is another fine example of how compounds cooperate inside of our bodies and why it is important to offer ourselves a rich, complex diet from natural sources! We will discuss again antioxidants and vitamin E in the exciting chapter "Antioxidants in Moringa" on p. 53. As with other antioxidants, the antioxidant ability of vitamin E contributes to prevent premature aging and degenerative diseases, including heart disease, arthritis, diabetes and cancer. It also protects the body from pollution, increases stamina, and reduces or prevents hot flashes in menopause. Vitamin E is also used externally in various creams for skin treatments, promoting young-looking skin, healing, and reducing scar tissue.

What is the daily recommended dose and how can Moringa contribute? Adults should ingest at least 10 mg per day of vitamin E together with a wide range of antioxidants like vitamin C and beta-carotene. If your diet includes plenty of refined carbohydrates and fried foods, if you are on birth control pills or hormone-replacement therapy, or if you are exposed to pollution (who isn't?), then more vitamin E might be needed. A good source of vitamin E should provide at least 10% of the daily needs, with relatively few calories. Remember, being liposoluble by nature, vitamin E is generally found in calorie-rich fatty foods . Moringa contains large amounts of vitamin E in the leaves (very few calories) and in the leaf powder - about 110 mg per 100 g of leaf powder or 100 g of oil. In addition, Moringa also contains antioxidants such as vitamin C, beta-carotene and others— just a great mix!

SUMMARY

Vitamins are absolutely essential for growth and maintenance of life and many are not produced by our bodies; therefore, they must be supplied by the diet.

Moringa is rich in many vitamins, particularly in vitamin C, provitamin A (beta-carotene), and vitamin B1 and E. These abundant vitamins in Moringa exceed those commonly found in most other plants.

Many of the vitamins in Moringa have powerful antioxidant and anti-aging properties.

A healthful diet, including plenty of fruits and vegetables is the best and safest source of vitamins.

"Verde que te quiero verde.
Verde viento.
Verde ramas."

"Green, I love you green.
Green Wind.
Green branches."

– Federico Garcia Lorca

BETA-SITOSTEROL IN MORINGA

Sterol Against Sterol

Hold on, this is not a scene from *Invasion of the Body Snatchers*, but rather a real biological "warfare" between two similar substances of the sterol family: beta-sitosterol and cholesterol. A sterol is a complex chemical related to steroid hormones but which also relates to alcohols. The sterols are naturally occurring substances in plants and animals and have many functions.

Cholesterol is mainly found in animals. It plays essential roles in the formation of cell membranes and synthesis of hormones and vitamin D; therefore its presence is vital for health. Too high levels in the blood (actually in the serum) are dangerous, though. High cholesterol levels are a main risk factor for cardiovascular disease. Beta-sitosterol is a specific plant sterol, from the family of phytosterols. As mentioned before, it has a chemical structure that is very similar to cholesterol, the much-maligned serum fat that we all try to keep under control.

Beta-sitosterol has been shown to reduce blood cholesterol levels! This is due to their competition for absorption in the intestines: since the two sterols are similar, beta-sitosterol "tricks" the intestines and inhibits the absorption of food cholesterol. In other words, although beta-sitosterol is not well absorbed by the body, when consumed with animal fat cholesterol, it efficiently blocks cholesterol absorption. Consequently, lower serum cholesterol levels can result. Beta-sitosterol also improves other blood lipids besides cholesterol levels, and brings them to a more normal range.

Here you have it: maybe you could enjoy your steak WITH Moringa after all! Maybe, but don't take this to an excess of steak, of course. Remember, the liver itself also produces cholesterol. (Please review "Fats in Moringa" on p. 30 for facts on fats and how Moringa's oleic acid can help.) Moringa is very rich in beta-sitosterol and related substances, and this is another excellent reason to include it in your diet. If you remember from the chapter on fats, Moringa contains another factor against high cholesterol: oleic acid. In any case, you might need extra beta-sitosterol. It is believed that the average American diet lacks this component, since it generally includes few veggies. Plant sterols like beta-sitosterol are also proven to be very beneficial in related symptoms. Even more, beta-sitosterol acts against some forms of cancer. It has been found to reduce the growth of prostate and colon cancer cells. Among other medical benefits of beta-sitosterol:

- It boosts the immune defense and has anti-inflammatory properties.
- It helps normalize blood sugar and supports the pancreas (which controls blood sugar through secretion of the hormone insulin).
- It helps to heal ulcers and alleviate cramps.

I think you get the idea–Moringa has many weapons against high cholesterol and its potential harmful effects.

PLANT HORMONES

Zeatin–a Powerful Anti-Aging Factor

By now, you must be impressed by the richness and versatility of this incredible tree. Everywhere it grows—in India or Niger, Arabic countries or Nicaragua—Moringa has been embraced and recognized as a valuable nutritive and healing source. In regions with harsh climates, where food resources are scarce, just 25 grams of Moringa leaf powder can provide a child with about half the protein, all the calcium and vitamin A, a quarter of vitamin C, and three quarters of the iron needed daily! What a nutritious power plant, indeed. Recent studies have discovered that Moringa might have even more exciting properties than previously thought. Biochemical analysis has revealed that the Moringa leaves and leaf powder contain unusually large amounts of plant hormones named cytokinins, such as zeatin and the related dihydrozeatin. Cytokinins function as plant hormones, which are naturally occurring growth promoters and factors that delay senescence (the process of aging) in many plants. Furthermore, research studies have shown that plant cytokinins may be very active in animals as well. We will discuss below the functions and significance of cytokinins in general and zeatin in particular, in the process of aging. You will be surprised to find out how zeatin can help your skin, hair and more. Remember when I called Moringa a beautician? If you were wondering then, now zeatin should solve this puzzle in a beautiful way.

Cytokinins are compounds with a structure resembling adenine, one of the major components of the genetic material encoding information in the cell nucleus. Cytokinins have been found in almost all higher plants, as well as simpler organisms such as fungi and bacteria (single-cell organisms); therefore they must play a vital role

in the lives of plants. Indeed, cytokinins regulate a wide number of processes, such as flowering, germination of seeds, healing of wounds, and the accumulation and synthesis of nutrients (proteins and minerals). Ultimately, cytokinins control plant growth by stimulating the cell division (known as cytokinesis) and multiplication of plant parts. They stimulate the synthesis of nucleic acids (which encode the genetic information necessary for cell functioning and multiplication) and proteins.
In other words, thanks to the dynamic cytokinins, plants know when to grow more leaves or when to expand their roots, when to sit silenced, or when they should bloom again. One could compare a cytokinin with the director of a huge philharmonic orchestra of cells. The director gives the entry for every cell type, I mean the start for division and growth, or signals their end. All has to be, of course, harmonious and perfectly in tune with Nature's music (seasons, light, temperature, humidity), otherwise plants would not survive.

In addition, cytokinins delay the aging, the destruction of plant tissues and postpone death. In the 1930s, it was discovered that tomato roots could be cultured in an artificial medium indefinitely, while continuing to grow roots, if they were supplied a natural plant extract containing what later proved to be cytokinins. Since then, scientists have uncovered many of the miraculous plant hormones and today there are more than 200 known natural and synthetic cytokinins. The most common and the most active naturally occurring cytokinin in plants is zeatin, which was first isolated from corn (named *Zea mays* in Latin). Let's explore now how zeatin can delay aging.

Cytokinins and Aging

How do cytokinins delay aging in plants? What about their effects on animals and humans? These questions are not yet fully answered, although new and exciting data reveals insights about their mechanism of action in plants and animals. Briefly, cytokinins may act through a number of ways to stimulate the enzymes and processes involved in regeneration of tissues, while protecting against degrading enzymes and damaging free radicals. (Enzymes are the workforce of the body, substances that activate or inactivate all physiological processes. However, some enzymes are involved in destroying and possibly damaging cellular structures.) In order to understand the effects of zeatin and other cytokinins, we should first review some of the key issues about aging in plants and animals. Aging is characterized by a declining ability to respond to stress, increased biochemical imbalances and the occurrence of diseases (especially degenerative diseases), with death as the ultimate consequence. While we tend to notice mostly the external effects of aging, for instance on skin and visual

acuity, actually aging occurs first at the level of the minuscule living units: the cells. Every day, cells age and die in our bodies, and in plants for that matter. Cellular senescence (aging) can be demonstrated in the laboratory: various isolated cells have a limited ability to divide in culture. In other words, they divide and grow for a fixed number of times, and then they stop multiplying and die. A variety of cell biology alterations occurs as the cells progress from young and vigorous, to old and dry. As a consequence, we all function according to a biological clock, ultimately dictated by our cells. Genetic and environmental factors may affect the lifespan of cells, and organisms as a whole.

Importantly, it is believed that certain nutrients may affect the rate and occurrence of aging! This gives much hope to many that human aging can be slowed and has spurred intense research efforts within the field of senescence. Surely enough, we all hope for a long and healthy life, but how to reach that is still under debate. Groucho Marx once said that anyone can get old; we just have to live long enough! Longevity requires that we nourish our bodies properly, support the extraordinary healing power within us, and fight diseases wisely by using natural laws and the best medicines. A wholesome diet that strengthens our inner powers and delays aging should include the necessary nutrients: plenty of vitamins, essential microelements and protective phytochemicals that minimize tissue damage inherently occurring with age. Among the phytochemicals, cytokinins might play a crucial role.

Various experiments have shown that cytokinins like zeatin or kinetin have potent anti-aging and protective effects in animals, including humans, that are similar to their activity in plants. Could that be possible, taking into consideration the physiological and anatomical differences between plant and animal kingdoms? Well, it seems so. Plants, like animals, do have regulated growth, determined phases of tissue differentiation, specialized cell types, and sophisticated communication between cells. Apart from obvious differences, plants and animals share a majority of biological compounds (proteins, lipids, sugars, vitamins, and minerals), and their genetic material encodes information according to similar formulas. Even basic cell organization is quite similar as well. Plant cytokinins might be physiologically compared to animal hormones—endogenous substances that control development, growth, metabolism, and other various functions in animals.

Zeatin, like kinetin and other cytokinins, has potent antioxidant properties. As described in the chapter dedicated to the antioxidants, aging can be equated to an increased oxidation of cell components such as proteins, genetic material and lipids. Upon oxidation, they change or lose their normal functions, thus leading to a

disruption of normal physiological processes. Plants are the main source of powerful antioxidant substances that can trap and neutralize the damaging free oxygen radicals. By acting as an antioxidant, zeatin becomes another valuable substance in the fight against premature aging. Evidence for the anti-aging effects of zeatin and other cytokinins is presented below.

• **Cytokinins have proven to delay biochemical modifications associated with aging in cultured human cells.** Experiments conducted in Denmark, in association with American researchers, have shown that kinetin solutions that are applied to human cells (fibroblasts) lead to significant delays in the onset of aging and cell death. The treated cells maintained much longer their youthful characteristics (biochemical composition, skeletal and shape organization, active protein and genetic material synthesis). They were not accumulating age-pigment-like substances. These effects are seen as preventative, since no additional cell divisions were triggered. Human cells were growing continuously and remained younger while under the influence of kinetin.

• **Zeatin protects the skin.** Zeatin has demonstrated even better properties than kinetin in a similar experimental system. Human skin cells treated with zeatin retain their functions longer, do not accumulate biochemical damage associated with aging, and are more resistant to environmental stresses. Besides its mechanism on cell growth, and as described above, zeatin has potent antioxidant properties. It can increase the activity of known antioxidant enzymes, such as catalases, that naturally fight aging and free oxygen radicals. In other words, zeatin acts synergistically with other inner anti-aging molecules, orchestrating a stronger offensive against senescence.

These impressive results have lead to the development of skin and hair care products containing kinetin and zeatin in Europe and the United States. These effective and unique preparations protect against environmental damage, delay skin aging, and improve skin barrier functions to allow better humidity retention and elasticity. In contrast with other anti-aging substances, cytokinins do not induce peeling, dryness or exfoliation with consequent thinning of the skin. In other words, youthful skin without risks! The effectiveness in maintaining normal cell functions and safety for local use could make cytokinins the ingredients of choice for preserving healthy skin. Another conclusion to be drawn from here is that cytokinins work in living animal organisms, not only in their cultured, isolated cells. Clinical studies with human subjects on cytokinin treatment have also demonstrated an excellent efficacy in photo-damaged skin (visible light and UV damage). These preparations reduced skin wrinkles and roughness within 8-24 weeks in almost all patients treated. Scientists are further testing and proposing the introduction of cytokinin combinations for even better activity.

• **Zeatin protects animals against neuronal toxicity induced by age-specific proteins.** One of the main characteristics of brain aging is the accumulation of modified, non-functional proteins that often aggregate as insoluble particles. These are named amyloids and are believed to play an essential role in the development of brain degenerative diseases such as dementia. Since people are living longer and the number of cases of dementia has increased dramatically, scientists are intensively looking for preventative treatments against age-related brain diseases. Studies have shown that zeatin administered to mice can effectively protect them against memory and brain performance loss triggered by amyloids and chemical agents. It makes sense to believe that, if zeatin is an antioxidant and stimulates proper skin cell functioning and metabolism, it could also work as an antioxidant and protector for the neurons (the brain's main cells). Further studies are ongoing to clarify the importance of zeatin.

• **Zeatin and cancer.** One of the most frequent diseases of old age **is cancer.** Actually "cancer" is a complex set of many diseases, all characterized by some common biochemical changes occurring in cancerous (tumor) cells. Cell oxidation plays a major role in cancer development. Due to accumulated defects in the genetic material, cells lose the tight growth and function control that keeps them healthy and "well-behaved." The cancerous cells start to divide too rapidly and many become nonfunctional, leading to tumors. Many of the tumor cells behave as "non-differentiated." The cells are unable to decide which type of structure and growth path to take. It was shown that zeatin can inhibit cancer cell growth by "directing" them on the right path, and differentiating them into normal cells. The normal cells thus regain the normal, tight control that keeps them from dividing chaotically. These studies on zeatin's effects in cancer are still ongoing, but they show great promise.

But what is the concentration of zeatin in Moringa? Is Moringa a common source of zeatin or rather an exceptional one? Zeatin is found in many, if not most, superior plants. The amount of zeatin in various plants or even the same plant may vary according to the phase of growth, season, temperature, part of the plant analyzed, the use of fertilizers, etc. Scientists have found zeatin in very low concentration in plants. Generally, plant hormones are very active substances; therefore their concentration does not need to be high. Of course, many plants have not been tested yet for zeatin concentrations, but for those tested, the zeatin amounts vary between .00002 and .02 mcg/g of material. The zeatin concentration in Moringa leaves gathered from various parts of the world was found to be very high, between 5 mcg and 200mcg/g of material, or thousands of times more concentrated than in most plants studied so far. [IBC Laboratory, Tucson, AZ] We do not yet know what is the significance of this unusually high amount of zeatin: maybe it

could be linked to the very fast growth of this plant, or to its extraordinary nutritive richness, or to both. Definitely, it is not just a coincidence. Moringa is so unusual in so many ways.

SUMMARY

Zeatin is a normal, dynamic hormone in many plants. It functions to control growth, healing, and the accumulation of nutrients.

Zeatin delays aging by its influence on cell division and antioxidant properties.

Zeatin protects animals against neuronal toxicity induced by age-specific factors.

Zeatin inhibits cancer cells in laboratory settings and induces their differentiation into normal cells.

Moringa is indeed extraordinarily rich in zeatin.

ANTIOXIDANTS IN MORINGA

Are you ready for a complex and exciting subject? If not, take a break and have a green tea, which is teeming with antioxidants. After you refresh yourself, come back, find a comfortable seat, and let's start. So far we have described a number of essential, vital nutrients for normal physiology. We just can't be healthy without them in the long run. Maybe your head is spinning with data, but don't worry, you will learn what is necessary with time. This is the last chapter dedicated to another extremely important group of naturally occurring substances in Moringa and in some other plants: the antioxidants. There is a tremendous amount of information and scientific data about antioxidants; you can find magazines and books dealing specifically with them. My purpose here is to give you a short but comprehensive introduction to some of the antioxidants found so far in Moringa.

- According to our present knowledge, Moringa contains specific plant pigments with demonstrated potent antioxidant properties such as the carotenoids (lutein, alpha-carotene and beta-carotene), xanthins, chlorophyll, and others.
- Moringa contains powerful antioxidant vitamins such as vitamin C, E and A (provitamin A as beta-carotene).
- Moringa has essential micronutrients with antioxidant activity or directly linked to this process: selenium and zinc.
- Moringa (leaves, seeds, pods) contains other phytochemicals with known powerful antioxidant ability such as kaempferol, quercetin, rutin, and caffeoylquinic acids.

But let me first explain in a few words what tissue oxidation really means and why it is so important to reduce its consequences at cellular level.

What is "Oxidation" or "Oxidative Stress?" Just by living, eating and breathing, our bodies produce free radicals every second, such as single oxygen molecules, superoxide radicals, nitric oxide, and other unstable oxygen- and nitrogen-containing molecules. Oxygen is vital for living on Earth—it is present in every cell and participates in every chemical reaction in the cells, one way or another—but its chemical combinations can be very unstable. These unstable, "restless" chemicals are missing electrons, and therefore are on a constant search for other molecules that might provide them with the needed electrons. Remember from chemistry class that any atom is stable (less or non-reactive) when its electrons (negatively charged particles) are paired. Electrons don't enjoy loneliness. Free radicals steal electrons from other molecules (proteins, lipids, genetic material, others) in the cells, and, in this process, they create other unstable molecules, creating a vicious cycle. This "unauthorized" theft of electrons is named oxidation. Oxidation of substances can be equated to damage and aging. Oxidative stress is caused by an excess of reactive free radicals, which our defense mechanisms can no longer remove.

Any cell in our body is subjected to the threat and damage of oxidation constantly. Of course, our cells don't just sit there and wait to be bombarded and destroyed; no, they have developed powerful methods of counterattack—the antioxidants. Antioxidants occur naturally in plants and animals, and they can belong to various chemical classes, as we have seen. They can be vitamins, enzymes, metals, or other chemical families. Without them, oxidation will quickly lead to irreversible damage and death of cells and tissues. Free radicals, or oxidants, ("electron thieves") attack all cells, work against our various tissues, impact the immune system (our guardian against infections and cancer), and play a major role in the development of all chronic degenerative diseases like atherosclerosis and Alzheimer's disease. Oxidation at the level of genetic material—which encodes all of the information required for normal function and replacement of "used" substances—leads to mutations, or changes in the encoded information, and the appearance of aberrant substances. It is believed that this is one of the mechanisms leading to cancer.

How Can Antioxidants Protect Against Oxidation? Antioxidants donate electrons. For instance, phytochemicals can donate an electron, accompanied by a hydrogen atom from their hydroxyl (OH) groups, to a free radical. This electron stabilizes and deactivates the damaging radical; it pairs its ex-lonely electron. In the process, the phytochemical becomes an "aroxyl" radical, which is considerably

more stable than the free radical it has annihilated. In other words, the antioxidant becomes a sort of radical but of a non-dangerous type. The overall result is the interruption of damaging oxidative chain reaction. The more hydroxyl groups (OH) an antioxidant has, the more powerful it is.

Now you can introduce the antioxidants, and ask for their protection in your prayers; they might be your best friends. Antioxidants are not only for replacement of the lost or "consumed" nutrients or buildup of the body and the support of new cells, but, very importantly, for supporting the fight against aging and damaging of each and every cell. No matter what diet suits you best or what you prefer to eat, or how many calories you consume, antioxidants have to be present in your diet if you love life. Moringa's antioxidants belong to various chemical classes, and research has shown that combinations of such compounds are very effective and powerful in neutralizing free radicals. Vitamin C works best in the presence of beta-carotene and selenium. Vitamin C (which we have learned is found abundantly in Moringa) also supports the antioxidant activity of polyphenols (compounds with many hydroxyl groups) such as the antioxidants quercetin or kaempferol, also found in Moringa leaves.

Alpha-carotene, a carotenoid related to beta-carotene, is another powerful antioxidant. Carotenoids are fat-soluble pigments that prevent oxidation in plant cells and act similarly in animals. This carotene can also be used by the body to produce vitamin A and it is believed that alpha-carotene may be more powerful than beta-carotene in inhibiting cancer (tumor) growth. All dietary carotenoids are thought to be very beneficial by decreasing the risk of diseases, particularly cardiovascular ones, certain cancers, and eye disease. Carotenoids enhance natural immunity and protect against infections and cancers. Other carotenoids that have been the most studied for these effects are lutein and zeaxanthin. Both are found in Moringa leaves. Long-term inadequate intake of carotenoids is associated with chronic diseases such as heart disease, cancers, and blindness. If you smoke cigarettes or drink alcohol, you may have lower-than-normal blood levels of carotenoids (cigarette smoke destroys carotenoids).

Lutein, another beneficial plant pigment, is especially recognized for its protective eye and skin effects. It is found in dark green leafy vegetables. 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. The more lutein, the better. Lutein promotes healthy eyes by reducing the risk of macular degeneration (irreversible damage of the retina, thus leading to blindness). As an antioxidant, it appears to reduce harmful free radicals,

and it also filters the high-energy, blue wavelengths of visible light. Blue light (from indoor lighting and sunlight) is believed to induce oxidative stress in human organs exposed to light, such as the eyes and skin. (Blue light is not an ultraviolet light of the invisible spectrum. Ultraviolet light is also dangerous for the eyes, though.) It is believed that most Americans do not get enough lutein in their diets. So eat your greens!

Zeaxanthin is another carotenoid beneficial for the eyes that is found in Moringa leaves. Scientists have established that zeaxanthin plays essential roles in protecting the retina of the eye from the negative effects of light. How can that be? The retina has a particular affinity for two carotenoids of the hundreds possibly present in a (healthy) diet, lutein and zeaxanthin. The retina selectively accumulates these two; therefore, their concentration is very high in the retina, specifically in the part known as "macula," which is responsible for visual acuity. Since lutein and zeaxanthin absorb blue light, and because they are powerful antioxidants, it is hypothesized that they protect the retina. Indeed, these two related carotenoids, lutein and zeaxanthin, are your best allies in the fight against macular degeneration, the most prevalent cause of vision loss in the elderly. More than 17 million Americans have symptoms of macular degeneration and about 2 million have functional blindness, while 500,000 new cases are diagnosed each year.

Other antioxidants in Moringa include kaempferol, quercetin, rutin and caffeoylquinic acids.

Quercetin, rutin and kaempferol are three related flavonoids (a type of phytochemicals) with powerful antioxidant properties. Moringa is very rich in these extremely active flavonoids. Their chemical structure is quite complicated and so are the details about doses and concentrations in various plants. But let's remain at the most important issue for us, and that is their health benefits. These flavonoids have been thoroughly researched for their anti-inflammatory, anti-allergic, antiatherosclerotic, anti-asthmatic, and anticancer properties. Quercetin inhibits the production and release of histamine and other allergic and inflammatory substances. Histamine is a substance that contributes to allergy symptoms such as runny nose, watery eyes, and swelling of soft tissue including the face. In laboratory and animal studies, quercetin and related flavonoids have exhibited anti-inflammatory properties; for example, quercetin has shown that it inhibits the type of inflammation that occurs in the joints of those with arthritis. Quercetin studies suggest that it decreases pain and other symptoms in men with chronic prostatitis (inflammation of the prostate) and may inhibit the growth of prostate cancer cells. Most of these effects are due

to its antioxidant properties, although these flavonoids might have specific effects on various tissues. Rutin and quercetin work together; that is they complement each other, and should be taken together. In Moringa you have them together. One of the major benefits of rutin is strengthening of capillaries (the finest blood vessels). Scientists believe that quercetin and rutin work together in decreasing capillary fragility and increasing arterial elasticity and, therefore, may help those who bruise or bleed easily. Other quercetin and rutin synergistic activities include:

- Stimulation of the elimination of cholesterol from the body.
- Helping the body to utilize vitamin C, another powerful antioxidant.
- Maintaining of the protein collagen, which is what keeps the skin healthy, elastic and firm (the breakdown of collagen is what leads to wrinkles).

Caffeoylquinic acids belong to a family of very well-studied antioxidants with incredible healing properties. The main plant known to contain such compounds and where most of the research was done is the artichoke (Cynara in Latin). Cynara is famous precisely for its content of caffeoylquinic acids and related compounds, which give it its hepatoprotector qualities. Cynara is present in multiple formulations around the world today, although it has been used since Roman times for the treatment and support of the liver and gallbladder. The Germans have thoroughly studied this miraculous plant and use it in various ailments of the gastrointestinal system, in children, adults, and the elderly. Around the world, Cynara extract is often standardized to contain 1-2% of caffeoylquinic acids. Moringa leaves contain 0.5-1% caffeoylquinic acids, coming very close to the content that makes Cynara famous! What benefits do caffeoylquinic acids really bring? They are considered choleretic (bile-increasing—bile is vital for the digestion of dietary fats), hepatoprotective (effective against hepatitis and other liver diseases), cholesterol-reducing, and diuretic. As you know, the liver is our chemical factory that digests food, produces energy, and detoxifies the body, to mention just a few of its main functions. The liver is the only organ that can regenerate itself if parts of it are removed, similar to the famous lizard's tail. Whenever the liver is sick, there is a total depletion of energy and vitality; those who have experienced hepatitis (inflammation and infection of the liver) can tell you about the terrifying feeling of total weakness. Caffeoylquinic acids, naturally occurring in plants, have been studied in clinical trials and have proven very safe and are extremely well tolerated by patients. They reduce the symptoms of abdominal pain, bloating, lack of appetite and nausea associated with liver and digestive disorders. Thinking about Moringa's benefits in hepatitis (traditionally used as such in India and other countries) I believe it is very possible that its beneficial hepatoprotector effects are due precisely to the presence of these potent antioxidant and pharmacologically active caffeoylquinic acids.

SUMMARY

During normal biological processes inside our bodies, unstable molecules—free radicals—are created. They attack every cell and damage the biological structures made of lipids, proteins, and genetic material.

Antioxidants produced by the body and supplied by food have to act promptly to stop the harm inflicted by free radicals at all levels.

The pollution and the stress of modern life, including poor diets, increase the oxidative stress and the production of free radicals.

Moringa contains potent antioxidants such as the carotenoids (lutein, beta-carotene, xanthins), vitamins (C, E and A), minerals (selenium) and other phytochemicals (quercetin, rutin and caffeoylquinic acids).

Complex mixtures of naturally occurring antioxidants from plants are the most effective and beneficial protectors against oxidation and aging of the tissues.

Diets including plenty of greens, vegetables, fruits and seeds have been linked with serious health benefits and a much lower incidence of various diseases.

"What we are doing to the forests of the world is but a mirror reflection of what we are doing to ourselves and to one another."
– Gandhi

FINAL THOUGHTS & Conclusion

It is time to say goodbye to our friend, Moringa. But beyond this book, and maybe in part because of it, Moringa will stay in your life to enrich it forever. Let us summarize the wonderful offerings of this tree. Let us seek inspiration from Nature, which is the greatest, most successful scientist and compassionate physician!

Let us remember that we, as humans are part of Nature. There is no other "external" environment; we are the environment. As such, we should function according to the basic rules of Nature for proper physical and mental health. Since we were meant to eat mostly plants, as omnivorous creatures, the best way to remain functional and healthy is to continue ingesting mostly plants, especially uncooked, unprocessed plants. Some might argue that animals feed while humans eat. In other words, we have transformed the basic ingestion of nutrients into a social, sophisticated event; we seek the pleasure and satisfaction (taste) above all. I personally think it is the lack of basic nutrition education that leaves some ignorant or indifferent to their true organic needs. The other main reason is the total dissociation from Nature—our own roots—and who we really are. The consequences are many and sad; among these, a plethora of chronic diseases and physical weaknesses. In the case of cancer, for instance, it is clear now that most types of cancer can be prevented or delayed by a healthy lifestyle, especially a diet rich in vitamins and antioxidants. Healthy lifestyle also means natural or "normal"—as normal as it used to be when we enjoyed clean food, water and air, and had to move a lot. Did you know that **there are thousands and thousands of scientific studies and publications about how cancer can be prevented by various plants or plant-derived substances?** By contrast, there are few, if any, studies showing that animal-based food can prevent cancers—on the contrary! Even baked foods (such as bread) and grilled meat have proven to contain

cancer-promoting substances. I do not mean to scare you, but rather to draw your attention to a crucial aspect of our diet and how is it connected to our poor state of health, from poor eyesight to cancer and heart disease.

If I have to choose the single most important group of substances that are really needed but are not well represented in the Western diet, I would select the antioxidants from plants. Green or colorful, canned or not, fresh better than cooked (although sometimes cooking preserves certain antioxidants), organic if possible, or whatever you can afford, just get back to your roots and eat what you were designed to eat for the best physical and mental state. You would be surprised to notice the positive changes and the energy you will draw from plants. If you really eat properly, when you leave the table you should feel light, energized and clear-minded. In the long run, you should rarely suffer from colds, constipation, or migraines, have fewer wrinkles and joint pains, possibly no need for eyeglasses, and no heartburn, high cholesterol or hypertension, to name just a few health troubles. If you suffer from any of these, your diet is not what it is supposed to be.

I briefly exposed some serious health threats and their link to the Western diet for a better appreciation of plant-derived foods and the role Moringa could play in a healthy diet. I trust plants to keep me healthy and energetic; I trust Nature to show me the path of wisdom in everything. After all, Nature has experimented on a large scale, and successfully created a myriad of solutions for hundreds of millions of years! Among them, we have the Miracle Tree, Moringa. In contrast, we humans have played and experimented with food for just a few thousand years or so (junk food is much younger, of course). We started to create and synthesize medicines less than a few hundred years ago.

This book introduced you to *Moringa oleifera*, an unusually beneficial tree in so many ways. My wish is that, upon reading it, you can understand her nutritional and medicinal value, and begin to appreciate Earth's amazing, still largely unknown green heritage. I have collected and put together information about Moringa's fame and extraordinary medicinal and nutritive qualities, and why introducing this plant into our diet could be so valuable. I hope to have covered the most significant and interesting facts, although I cannot claim to have covered all, or satisfied everybody. Please keep in mind that Moringa is studied and grown in many parts of the world, within various climates and conditions; therefore, the biological data and nutritive contents can vary widely from place to place.

Besides this book, there are other valuable resources on Moringa out there, many web sites and related articles, cooking recipes, seed sources, and others. Please review the "References and Resources of Information on Moringa" on p. 63. The book *Moringa, Nature's Medicine Cabinet*, by S. Holst, includes many cooking recipes using various parts of the plant. Unfortunately, it is very difficult to find fresh Moringa on the Western markets, but one can find canned or frozen pods in gourmet stores and some Asian markets. I keep growing this wonderful plant for a continuous supply in my own house, although I hope some day we will have tasty Moringa products readily available everywhere.

In summary: *Moringa oleifera* is extremely rich in vital nutrients, and, as a bonus, can grow very fast even in dry areas of the world, where food is scarce. Since ancient times, she was used as a medicinal plant, known to heal and ease a wide number of diseases, from various inflammations to cancer, from parasitic diseases to diabetes. In more recent times, Moringa has gained notoriety as a nutrition power plant that can feed the needy and, in fact, save lives. Moringa leaves or leaf powder can be used successfully as a complex food to nourish small children, pregnant or nursing women, and, of course, anybody else. In terms of nutrients, the leaves contain all the essential amino acids, present in harmonious combinations and significant amounts, readily bioavailable. Moringa can be, from this point of view, better than or at least as good as soybeans and soy protein.

Sadly, all over the world most people lack adequate access to fresh vegetables, and we know that these are vital in maintaining good health. Malnutrition is frequent in the tropics but it spreads now as more drought threatens other parts of the world due to global warming. Moringa can grow (fast!) in dry areas, it is an outstanding source of nutrients, and is a very resilient plant. I personally believe that few, if any other plants can provide more for humans and animals than Moringa. Moringa is our hope in a drier, warmer world.

Moringa seeds are rich in an excellent oil, very similar in quality and composition to olive oil, one of the healthiest, most studied fats. The replacement of animal fats in the diet with vegetal fats such as olive or related oils has been clearly linked to beneficial health effects and reduction in cardiovascular diseases and cancers. The list of Moringa's nutrients goes on: essential minerals such as calcium, potassium, iron, and selenium are present in Moringa, often more abundantly than in most plant sources. Iron is much higher in Moringa than in spinach, for instance. Vitamins C, B1, B2, E, and provitamin A are also present in significant quantities that make oranges or carrots pale in comparison. In addition, Moringa contains numerous phytochemicals

(specific plant-derived chemicals) that act as antioxidants or anti-aging substances, stimulating rejuvenation of skin and mucosa, or energizing and detoxifying the body. These beneficial substances are hormones (zeatin) and plant pigments such as rutin and quercetin, to name just a few. All these naturally occurring nutrients of Moringa are known to be best absorbed and active in the body if derived from natural sources (such as plants), and are present in complex combinations. Many of these beneficial substances act synergistically, enhancing each other's properties.

Very exciting are Moringa's medicinal properties, as described in the chapter dedicated to the medicinal uses of this plant around the world. What is more interesting is that science continues to validate the ancient, traditional therapeutic uses of Moringa. The list of valuable, recent medicinal discoveries related to Moringa is very rich; one would need hundreds of pages to mention them all. Still, there is a clear need for more research, especially clinical studies in humans.

Nevertheless, recent scientific studies have demonstrated a few excellent beneficial effects of Moringa in diabetes, atherosclerosis, hyperlipidaemia, wound healing, infections and others. Moringa was shown to contain potent hepatoprotective substances that protect the liver against chemical or drug damage.

Compared to some of the modern, valuable drugs against atherosclerosis (hardening of the arteries which may lead to severe complications such as stroke and myocardial infarction) Moringa leaves fared very well, the leaf extract significantly inhibited the formation of atherosclerotic plaques in the arteries. The authors of the study suggest that Moringa may provide a local, safe and affordable medicine for the prevention of cardiovascular diseases.

Moringa was also shown to contain powerful antibiotics, some with activity against *Staphylococcus aureus*, a common but potentially dangerous bacteria resistant to many modern antibiotics.

Now that you begin to understand the value of this plant to humanity, all those affectionate names people gave Moringa—"Miracle Tree," "Mother's Best Friend," and "Never Die"—make sense, don't they? I could not think of better names.

Enjoy your Moringa!

REFERENCES AND RESOURCES
of Information on Moringa

Introducing Moringa
Moringa in the News

Fuglie, Lowell J. "The Miracle Tree. *Moringa oleifera*: Natural Nutrition for the Tropics." Church World Service. 1999.

"Moringa Tree Could Reduce Malnutrition in Africa." United Methodist News Service, (UMNS), 24 Apr 2000.

Vietmeyer, N. "New crops: Solutions for global problems." Progress in New Crops. Ed. J. Janick. Alexandria, Virginia: ASHS Press, 1996, p. 2-8

Folkard, Geoff, and John Sutherland. "*Moringa oleifera:* A Tree and a Litany of Potential." Agroforestry Today 8(3), 1996, p. 5-8.

Fritz, Mark. "Gnarly Tree Can Cure the Ill, Purify Water and Feed the Hungry, A Common Tree with Rare Power." Los Angeles Times 27 Mar 2000, p. A1, A14.

Bazeley, B.W. "Moringa: a miracle tree for developing countries?" The Rotarian Feb 1999, p. 6.

Sreenivasan, Jyotsna. "The Drumstick Tree: A Natural Multi-Vitamin—Moringa tree cheap solution to malnutrition in Africa." The Environmental Magazine May 2000.

Ramachandran, C., Peter, K.V., and P.K. Gopalakrishan. "Drumstic (*Moringa oleifera*): A multipurpose Indian vegetable." Economic Botany 34(3), 1980, p. 276-83.

The potential of *Moringa oleifera* for agricultural and industrial uses, Communication at "Development potential for Moringa products," Dar es Salaam, Tanzania, Oct-Nov 2001.

Moringa, the Medicinal Plant

Koneni V. et al. "Rare dipeptide and urea derivatives from roots of *Moringa oleifera* as potential anti-inflammatory and antinociceptive agents. European Journal of Medicinal Chemistry 44(1), 2009. p. 432-6.

Chumarka, Pilaipark et al. "The *in vitro* and *ex vivo* antioxidant properties, hypolipidaemic and antiatherosclerotic activities of water extract of *Moringa oleifera* Lam. Leaves." Journal of Ethnopharmacology 116(3), March 2008, p. 439-46.

Fakurazi, S. et al. "*Moringa oleifera* Lam prevents acetaminophen induced liver injury through restoration of glutathione level." Food and Chemical Toxicology 46, 2008, p. 2611–5.

Mehta, Komal et al. "Effect of fruits of *Moringa oleifera* on the lipid profile of normal and hypercholesterolaemic rabbits." Journal of Ethnopharmacology 86, 2003, p. 191-5.

Spiliotis V.S. et al. "Comparison of antimicrobial activity of seeds of different *Moringa oleifera* varieties." Pharmaceutical and Pharmacological Letters 8(1), 1998, p. 39-40.

Gambari, Roberto and Ilaria Lampronti. "Inhibition of immunodeficiency type-1 virus (HIV-1) life cycle by medicinal plant extracts and plant-derived compounds." Advances in Phytomedicine 2, 2006, p. 299-311.

John, S. and A.R. Chellappa. "Hypoglycemic effect of *Moringa oleifera* (drumstick) leaf powder on human diabetic subjects and albino rats." Indian Journal of Nutrition and Dietetics 42(1), 2005, p. 22-9.

Hukkeri, V.I. et al. "Antipyretic and Wound Healing Activities of *Moringa oleifera* Lam. in Rats." Indian Journal of Pharmaceutical Sciences 2006, p. 124.

Fahey, J. W. "*Moringa oleifera*: A Review of the Medical Evidence for its Nutritional,

Therapeutic, and Prophylactic Properties. Part 1." Trees for Life Journal 1(5), 2005.

Holst, Sanford. Moringa, Nature's Medicine Cabinet. Sierra Sunrise Publishing, 2000.

Faizi, S. et al. "Hypotensive constituents from the pods of *Moringa oleifera*." Planta Med 64, April 1998, p. 225.

Pal, S.K., Mukherjee, P.K. and B.P. Saha. "Studies on the antiulcer activity of *Moringa oleifera* leaf extract on gastric ulcer models in rats." Phytotherapy Research 9, 1995, pp. 463-65, 1995.

Eilert, U. et al. "The antibiotic principle of seeds of *Moringa oleifera* and *Moringa stenopetala*." Planta Res 42, 1981, p. 55-61.

Udupa, S.L. et al. "Studies on the anti-inflammatory and wound healing properties of *Moringa oleifera* and *Aegle marmelos*." Fitoterapia 65(2), 1994, p. 119-23.

Faizi, S. et al. "Isolation and structure elucidation of new nitrile and mustard oil glycosides from *Moringa oleifera* and their effect on blood pressure. Journal of Natural Products 57(9), 1994, p. 1256-61.

Jayavardhanan, K.K. et al. "Modulatory potency of drumstick lectin on the host defense system." J Exp Clin Cancer Res 13(3), 1994, p. 205-9.

Morton, J. F. "The horseradish tree, *Moringa pterygosperma* (Moringaceae)—A boon to arid lands?" Economic Botany 45(3), 1991, p. 318-33.

Murakami, A. et al. "Niaziminin, a thiocarbamate from the leaves of *Moringa oleifera*, holds a strict structural requirement for inhibition of tumor-promoter-induced Epstein-Barr virus activation." Planta Med 64(4), May 1998, p. 319-23.

Kumar, N. Ashok. "Antioxidant Action of *Moringa oleifera Lam.* (Drumstick) Against Antitubercular Drugs Induced Lipid Peroxidation in Rats." Journal of Medicinal Food 6(3), Oct 2003, p. 255-9.

Jansakul, Chaweewan et al. "Pharmacological studies of thiocarbamate glycosides isolated from *Moringa oleifera*." J Sci Soc Thailand 23, 1997, p. 335-46.

Limaye, D.A. et al. "Pharmacological investigations on aqueous extract of *Moringa*

pterygosperma." Phytotherapy Research 8(37), 1995.

Nwobodo, Ghasi S. et al. "Hypocholesterolemic effects of crude extract of leaf of *Moringa oleifera Lam* in high-fat diet fed wistar rats." J Ethnopharmacol 69(1), Jan 2000, p. 21-5.

Guevara, A.P. et al. "An antitumor promoter from *Moringa oleifera Lam*." Mutat Res 440(2), 6 Apr 1999, p. 181-8.

Moringa, the Nutritive Plant

Hosken, Fran P. Stopping Malnutrition in the Tropics with the Moringa Tree." Women's International Network News 26(2), 2000, p. 47-8.

Ram, J. "Moringa, a highly nutritious vegetable tree." Tropical Rural and Island/Atoll Development Experimental Station (TRIADES) Technical Bulletin No. 2, 1994.

Ramachandran, C. et al. "Drumstick (*Moringa oleifera*): A multipurpose Indian Vegetable." Economic Botany 34(3), 1980, p. 276-83.

Verma, S.C. et al. "Nutritional value of Moringa." Current Sci 45(21), 1976, p. 769-70.

Morton, J. F. "The horseradish tree, Moringa pterygosperma (Moringaceae)—A boon to arid lands?" Economic Botany 45(3), 1991, p. 318-33.

Makkar, H. and K. Becker. "Nutrients and anti-quality factors in different morphological parts of the *Moringa oleifera* tree." Journal of Agricultural Sciences 128, 1997, p. 311-22.

Makkar, H. and K. Becker. "Nutritional value and antinutritional components of whole and ethanol extracted *Moringa oleifera* leaves." Animal Feed Science and Technology 63(1-4), Dec 1996, p. 211-28.

Foidl, N., H. Makkar, and K. Becker. "The potential of *Moringa oleifera* for agricultural and industrial uses." Communication at "Development potential for Moringa products," Dar es Salaam, Tanzania, Oct-Nov 2001.

Fuglie, Lowell J. "The Miracle Tree: *Moringa oleifera*: Natural Nutrition for the Tropics.

Training Manual." 2001. Church World Service. <www.moringatrees.org/moringa/miracletree.html>.

Fuglie, Lowell J. "The Miracle Tree. *Moringa oleifera*: Natural Nutrition for the Tropics." Church World Service. 1999.

Becker, K. "*Moringa olifeira*—an underutilised tree with amazing versatility." Workgroup Multifunctional Plants—Food, Feed, Industrial Products. Indonesia, 2003.

Lee, S.J. and J.A. Kanis. "An association between osteoporosis and premenstrual symptoms and postmenopausal symptoms." Bone and Mineral 24, 1994, p. 127-34.

Kushi, L. and E. Giovannucci. "Dietary fat and cancer." E Am J Med 113(9B), 2002, p. 63S-70S.

Hu F.B. et al. "Types of dietary fat and risk of coronary heart disease: a critical review." J Am Coll Nutr 20, 2001, p. 5-19.

Budwig, J. Flax oil as a true aid against arthritis, heart infarction, cancer and other diseases. Apple Publishing, 1982.

Willett, W.C. et al. "Intake of trans fatty acids and risk of coronary heart disease among women." Lancet 341, 1996, p. 581-5.

Tsaknis, J. et al. "Characterization of *Moringa oleifera* variety Mbololo seed oil of Kenya." J Agric Food Chem 47(1), Nov 1999, p. 4495-9.

Assmann, G. et al. "Olive Oil and the Mediterranean Diet: Implications for Health in Europe." Br J Nurs 6, 1997, p. 675-7.

de Lorgeril, M. et al. "Mediterranean Dietary Pattern in a Randomized Trial: Prolonged Survival and Possible Reduced Cancer Rate." Arch Intern Med 158, 1998. p. 1181-7.

Visioli, F. and C. Galli. "Antiatherogenic Components of Olive Oil." Curr Atheroscler Rep 3, 2001, p. 64-7.

Higdon, Jane. Evidence-Based Approach to Vitamins and Minerals: Health

Implications and Intake Recommendations. Thieme Medical Pub, 2003.

Lee, I.M. et al. "Beta-carotene supplementation and incidence of cancer and cardiovascular disease: the Women's Health Study." J Natl Cancer Inst 91, 1999, p. 2102-6.

Hennekens, C.H. et al. "Lack of effect of long-term supplementation with beta carotene on the incidence of malignant neoplasms and cardiovascular disease." N Engl J Med 334, 1996, p. 1145-9.

Donaldson, Michael S. "Nutrition and cancer: A review of the evidence for an anti-cancer diet." Nutr J 3(1), 20 Oct 2004, p. 19.

Waladkhani, A.R. and M.R. Clemens. "Effect of dietary phytochemicals on cancer development." Int J Mol Med 1(4), Apr 1998, p. 747-53.

Dreikorn, K. "The role of phytotherapy in treating lower urinary tract symptoms and benign prostatic hyperplasia." World J Urol 19(6), Apr 2002, p. 426-35.

Ishii, Y., Y. Honma, et al. "Control of differentiation and apoptosis of human myeloid leukemia cells by cytokinins and cytokinin nucleosides, plant redifferentiation-inducing hormones." Cell Growth Differ 13(1), Jan 2002, p. 19-26.

Rattan, S.I. and B.F. Clark. "Kinetin delays the onset of aging characteristics in human fibroblasts." Biochem Biophys Res Commun 201, 1994, p. 665-72.

Verbeke, P. et al. "Kinetin inhibits protein oxidation and glycoxidation in vitro." Biochem Biophys Res Commun 276(3), Oct 2000, p. 1265-70.

Sharma, S.P., P. Kaur, and S.I. Rattan. "Plant growth hormone kinetin delays aging, prolongs the lifespan and slows down development of the fruitfly *Zaprionus Paravittiger*." Biochem Biophys Res Commun 216(3), 22 Nov 1995, p. 1067-71.

Heo, H.J., S.C. Hong et al. "Inhibitory effect of zeatin, isolated from Fiatoua villosa, on acetylcholinesterase activity from PC12 cells." Mol Cells 13(1), 28 Feb 2002, p. 113-7.

Letham, D.S. "Zeatin, a factor inducing cell division isolated from Zea mays." Life Sci 8, 1963, p. 569-73.

Siddhuraju, P. and K. Becker. "Antioxidant properties of various solvent extracts of total phenolic constituents from three different agroclimatic origins of drumstick tree (*Moringa oleifera Lam.*) leaves." J Agric Food Chem 51(8), 9 Apr 2003, p. 2144-55.

Ambau, Getty T. Importance Of Good Nutrition, Herbs And Phytochemicals: For Your Health, Good Looks. Falcon Press International.

Balch, James F. Super Anti-Oxidants: Why They Will Change the Face of Healthcare in the 21st Century. Natl. Book Network, 1999.

.

Bennett, R.N. et al. "Profiling glucosinolates and phenolics in vegetative and reproductive tissues of the multi-purpose trees *Moringa oleifera L.* (horseradish tree) and *Moringa stenopetala*." J Agric Food Chem 51(12), 4 Jun 2003, p. 3546-53.

Skaper, S.D., M. Fabris, et al. "Quercetin protects cutaneous tissue-associated cell types including sensory neurons from oxidative stress induced by glutathione depletion: cooperative effects of ascorbic acid." Free Radic Biol Med 22(4), 1997, p. 669-78.

Bartlett, H. and F. Eperjesi. "An ideal ocular nutritional supplement?" Ophthalmic Physiol Opt 24.(4), Jul 2004, p. 339-49.

Alves-Rodrigues, A. and A. Shao. "The science behind lutein." Toxicol Lett 150(1), 15 Apr 2004, p. 57-83.

Weisburger, J.H. "Antimutagens, anticarcinogens, and effective worldwide cancer prevention." J Environ Pathol Toxicol Oncol 18(2), 1999, p. 85-93.

Prior, R.L. "Fruits and vegetables in the prevention of cellular oxidative damage." Am J Clin Nutr 78(3), Sep 2003, p. 570S-78S.

Jayaraj, A. et al. "Insulin Secretagogues from *Moringa oleifera* with Cyclooxygenase Enzyme and Lipid Peroxidation Inhibitory Activities." Helvetica Chimica Acta 87(2), Feb 2004, p. 317-26.

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In April 2008, the USA National Institutes of Health (NIH), one of the most respected scientific institutions in the world, celebrated Earth Day with exhibits, posters, programs dedicated to Moringa. The NIH Record publication mentions: **"perhaps like no other single species this plant has the potential to help reverse multiple major environmental problems and provide for many unmet human needs."**

Monica G. Marcu, a clinical pharmacologist, has been "in love with trees," as she puts it, ever since she can remember. This led her to study plants, and particularly medicinal plants.

Monica now uses her love of healing plants to study ways to cure disease. She has worked in clinical pharmacies and in biomedical research laboratories at the University of Ottawa and the National Institutes of Health-National Cancer Institute (N.C.I.). Monica has conducted extensive pharmacological and biological research, and has more than 80 publications. She has received awards and honors from the American Association for Cancer Research, N.I.H., and the N.C.I., as well as other organizations.

Monica holds a Ph.D. in pharmacology, a Pharm.D. (doctor in pharmacy), a nursing degree, and fine arts degree. In her spare time she is an avid nature photographer. She and her husband, Michael Podina, currently resides in Seattle.

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• Supports detoxification and neutralization of toxins and pollutants by stimulating detoxifying enzymes.

While the recommended dose is only 60 mg of vitamin C per day (and that is found in just an ounce of Moringa leaves!), many argue for much higher needs – at least 2 grams per day. But some claim that so much vitamin C is useless or even dangerous to our health.

Hmm…Who should I believe? Most of the time I personally use my "BEAR method." Since our closest relatives in what concerns the digestive system, are omnivorous animals such as bears and monkeys (primates) who enjoy huge amounts of fresh greens and fruits loaded with vitamin C, daily, we humans could also require huge amounts of vitamin C for proper health. In any case, 1-2 g of vitamin C cannot be dangerous to us; this is probably the amount of vitamin C that our ancestors ate during most of their long development as part of the animal kingdom, when they used to inhabit the wilderness.

There is a wealth of evidence about better health and reduced death rates from heart disease, cancer and other diseases, with 1-2 g of vitamin C per day for an adult. The more greens and fruits, the better. To enhance its antioxidant properties, it is best to supply vitamin C with other antioxidants, especially those found in plants, as there is strong evidence of synergy between various antioxidants. In other words, birds of a feather …work together! Since Moringa is also rich in various other antioxidants, it makes clear sense to consider it as an excellent source of bioavailable and efficient vitamin C.

The B-Complex of Vitamins—to B or not to B Healthy?

The following vitamins are part of a complex group of vital factors for our health. Their deficiency leads to serious diseases. Moringa is an excellent source of vitamins from the B-complex group.

Vitamin B1, also known as thiamin, was the first B-vitamin to be discovered. It is part of a large group of water-soluble vitamins, the B-complex group. Vitamin B1 is vital for the production of energy within every cell and plays an essential role in the metabolism of various sugars (carbohydrates), which are a major source of energy. This vitamin is also needed for the processing of fats and proteins and for the normal function of the nervous system, heart and muscles. For instance, vitamin B1 supports healthy development of the fat-like layer which surrounds most nerves, called the myelin sheath. In the absence of vitamin B1, this layer can degenerate or

today, although it is safe to say that most people in the Western world probably do not need multivitamins regularly. Of course, a medical prescription is an exception. In addition, many suppliers offer vitamins that are not truly absorbed due to poor formulations. These vitamins are not truly "bioavailable" (absorbable and available for maximum effectiveness to the body). Alternatively, all humans need complex, natural vitamins provided by a nutritious diet consisting mostly of plants (leaves, fruits, seeds, roots, sprouts, legumes, mushrooms, etc.). Remember, nutrients are meant to work in a delicate balance with each other, not as separate compounds, as often formulated in pills, capsules and tablets.

Vitamin C A superstar among stars, vitamin C (ascorbic acid) is one of the best-studied substances supplied by the diet. This water-soluble vitamin is not a coenzyme but rather is required, among others, for the synthesis of collagen, a protein of the connective tissue in vertebrates. It does not sound too important but, in fact, without collagen our bodies would fall apart. One of the main symptoms of scurvy, stemming from lack of vitamin C, is the loss of teeth, but this is just the beginning of a painful, deadly disease. Scurvy is rare today but mild vitamin C deficiency is probably frequent. This is due to the fact that vitamin C is very sensitive and easily lost during cooking and processing of foods. Fresh fruits and greens have bioavailable vitamin C in various amounts. Juicing fruits and vegetables is also a great way of supplying vitamin C.

Since the human body is unable to manufacture vitamin C, we must acquire it from our diets -read PLANTS. Moringa contains abundant amounts of vitamin C. 100 g Moringa leaves contain more than 200 mg vitamin C, while 100 g orange juice has only about 40 mg of vitamin C. As you know, citrus fruits such as oranges and limes are considered to be among the best sources of vitamin C, until Moringa.

Vitamin C is surrounded by some controversy in terms of daily allowance and uses. All this fuss about vitamin C is due to its many other functions besides collagen formation. Some of the functions of vitamin C currently known are listed below:

- Supports and enhances the immune system in many ways; it has antiviral, antibacterial and anticancer properties.
- Supports the function and vitality of blood vessels. Therefore, it is beneficial in various conditions such as coronary disease that affects the heart arteries.
- Has powerful antioxidant capacity and anti-aging properties. Vitamin C combats the oxidation of lipids, which has been linked to degeneration and premature aging, and works inside the cells to protect the genetic material from damage caused by free radicals. (Please review the chapter dedicated to antioxidants on p. 53.)