

THE MORINGA TREE

*A local solution to
malnutrition?*

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INTRODUCTION

This document is aimed at describing the causes and effects of malnutrition in the third world, efforts being made to overcome this problem, and the potential benefits of using the products of the Moringa tree – a natural resource present in most tropic and sub-tropic countries – in helping address this in a local and cost-effective manner.

This paper is divided into three sections: 1). Malnutrition causes and effects; 2). Moringa as a possible home-gardening solution much of the malnutrition in the third world; and 3). Vernacular names for the Moringa tree in African countries.

Section one begins with a call by the U.N. Secretary-General Kofi Annan for a “green revolution” to take place in Africa which is “the only continent where child malnutrition is getting worse rather than better.” This is followed by identifying deficiencies of micronutrients (iodine, iron, vitamin A and zinc) in diets as an underlying cause of morbidity and mortality, studies done in Nepal and India to measure the impact of supplementing diets with micronutrient doses, WHO recommendations in this approach, and case studies in three countries in Africa which determined that this approach is not effective due to “the extent of missed opportunities to deliver nutrition services during routine prenatal, postnatal and child-care consultations for the prevention and treatment of highly prevalent nutritional deficiencies.” The summary of this section describes the current problems of recurring malnutrition in the third world. Quoting from experts in this subject, “in Africa as a whole, just under 40% of its children are chronically malnourished. ... This is due to a poor quality diet.”

“Malnutrition causes a great deal of human suffering and is associated with more than half of all deaths of children worldwide. Malnutrition severely impacts on the socio-economic development of a nation because a work force that is stunted both mentally and physically may have a reduced work capacity. The interaction of poverty, poor health and poor nutrition has a multiplier effect on the general welfare of the population and also contributes significantly towards keeping a population in a downward trend of poverty and nutritional insecurity. Thus nutrition plays an important role in the reproduction of poverty from one generation to the next.”

Section two begins with the summary of a study done in South Africa which demonstrates the beneficial effects of home gardening to address vitamin A deficiency, followed by a laboratory study showing the bioavailability of vitamin A in the fresh and dried Moringa leaves. Two documents summarize traditional uses of *Moringa oleifera* and its cousin *Moringa stenopetala* among certain African populations in Nigeria and Ethiopia to address food needs (although *M.oleifera* is also part of traditional diets in other countries, including Senegal and The Gambia). Page 20 provides a laboratory analysis of the nutritional components of Moringa pods, leaves and leaf powder. This is followed by a growing international recognition of the exceptional value of using Moringa to address micronutrient and macronutrient needs.

Why is Moringa's value not yet accepted or used by international agencies like UNICEF, WHO and WFP? The obstacles preventing this acceptance are summarized on page 26. But many of these obstacles are addressed in a recently-published book about Moringa's nutritional value and potentials, with excerpts quoted on pages 27-31.

The summary of this document is an effort to describe the advantages of using Moringa in malnutrition prevention programs. Section C on pages 34-35 give evidence that the Moringa tree is already present in most countries in Africa, thus providing a local and easily accessible natural resource for use in nutrition programs.

A. MALNUTRITION CAUSES AND EFFECTS

Annan calls for a green revolution to reduce hunger

ADDIS ABABA, 6 July 2004 (IRIN)

United Nations Secretary-General Kofi Annan said on Monday that halving hunger in Africa by 2015 under global anti-poverty goals seemed more of a "far-off fantasy" than an achievable target. He called for a "green revolution" if the lives of 200 million people suffering from chronic hunger on the continent were to be radically changed.

"Africa is the only continent where child malnutrition is getting worse rather than better," Annan said. "Tragically, the past decade has seen very little progress."

Addressing an audience which included seven African leaders, scientists and development experts, he said the green revolution in Asia had tripled food productivity there. "Africa has not yet had a green revolution of its own," he told a seminar on reducing hunger at the UN Conference Centre in the Ethiopian capital, Addis Ababa.

Women often bore the brunt of shortages, Annan noted, adding that they also did "the lion's share" of agricultural work, preparing food and gathering water and firewood. However, they lacked access to credit and technology training, and were often denied legal rights, including the right to own land, he said. Girls, Annan noted, suffered disproportionately in terms of nutrition, with the result that they gave birth to underweight children. "Thus the plight of poverty and disease is carried forward to the next generation," he said.

"We are here today to end this pattern, and ensure that Africa's children enjoy a different inheritance," he stressed. He argued that by applying scientific and technological know-how, the continent could generate its own green revolution for the 21st century. This would involve the expansion of small-scale irrigation, the improvement of soil health, electrification and the provision of access to information technology and hunger early warning schemes.

Annan also dwelt on the AIDS pandemic, which is claiming 6,500 African lives a day, thereby robbing the continent of a generation of farmers. "In Africa, fighting hunger and fighting AIDS must go hand in hand," he said.

The seminar addressed by Annan was jointly sponsored by the UN Millennium Project Task Force on Hunger and the Ethiopian government, and was entitled "Innovative Approaches to Meeting the Hunger MDG in Africa". Participants in the high-level gathering will focus on practical and innovative steps to halve the number of hungry and malnourished people in Africa by 2015. They aim to address ways of improving agriculture, health care and nutrition, and of rectifying weaknesses brought about by poor infrastructure, weak markets and massive environmental degradation.[ENDS]

Micronutrient deficiency:

An underlying cause of morbidity and mortality

By Black R. Bulletin of the World Health Organization. February 2003; 81 (2): 79.

Micronutrient deficiencies are now recognized as an important contributor to the global burden of disease. Iodine deficiency in pregnancy has long been linked to intra-uterine brain damage and possible fetal wastage. This has led to effective programs for making iodized salt available in iodine-deficient areas. Currently, while more than two billion people live in areas that used to be iodine-deficient, it is estimated that iodine deficiency is the attributable cause of only 0.2% of the global burden of disease.

Iron deficiency also affects about two billion people. However, interventions to control iron deficiency have been less successful. Recent estimates find that iron deficiency anemia is responsible for a fifth of early neonatal mortality and a tenth of maternal mortality. Iron deficiency also reduces cognitive development and work performance. Iron deficiency is the attributable cause of about 800,000 deaths and 2.4% of the global burden of disease.

Vitamin A deficiency (VAD) harms the eyes and increases childhood and maternal mortality. Globally, 21% of children have vitamin A deficiency and suffer increased rates of death from diarrhea, measles, and malaria. About 800,000 deaths in children and women of reproductive age are attributable to VAD which accounts for 1.8% of the global burden of disease. This appears to be lower than previous estimates, possibly because of vitamin A supplementation or food fortification programs during the last decade.

The importance of zinc deficiency is being increasingly recognized. Trials have shown that zinc supplementation results in improved growth in children, lower rates of diarrhea, malaria, and pneumonia, and reduced child mortality. In total about 800,000 child deaths per year are attributable to zinc deficiency. Zinc deficiency is the attributable cause of 1.9% of global burden of disease.

According to WHO, 19% of the 10.8 million child deaths globally a year are attributable to iodine, iron, vitamin A, and zinc deficiencies. Recent estimates indicate that fortification or supplementation with iron, vitamin A, and zinc are among the most cost-effective interventions available, even in areas that are poor or have high HIV infection rates, as is the case in much of sub-Saharan Africa. The reduction of illness and disabilities such as cognitive impairment and decreased work capacity can have a strong positive effect on social and economic development of sub-Saharan Africa and should merit the highest priority for national programs and donor investment.

Maternal Postpartum Vitamin A Dosing Programs: Expected Impact and Current Guidelines

MOST Project. Frequently Asked Questions Series No. 4, 2001.

www.mostproject.org

In 1998, WHO recommended that in areas where vitamin A deficiency (VAD) is prevalent, women be provided with a high-dose vitamin A supplement in the early postpartum. Postpartum dosing improves maternal vitamin A status and increases the vitamin A content of breast milk for at least six months. This means more vitamin A for the breast-feeding infant. Maternal postpartum dosing improves the vitamin A status of infants and enhances their vitamin stores up to six months when infants begin to be at a much higher risk of developing VAD. Postpartum dosing may also decrease infant morbidity and mortality while improving maternal health. To date, no adverse side effects have been reported from postpartum dosing trials.

Current guidelines for these programs are that in areas where VAD is a problem of public health concern, mothers who are breastfeeding be provided with a high-potency vitamin A oral supplement containing 200,000 International Units (IU) within 8 weeks postpartum. Mothers who are not breastfeeding should receive the same dose within 6 weeks postpartum. The effectiveness of the recommended dose (200,000 IU) has been questioned. Some consider that such dose is probably too low for women living in areas where VAD is prevalent. A recent informal consultation organized by WHO (2001) recommended that doses to postpartum women be increased to 400,000 IU (in two 200,000 doses during the pre-conceptual period). IVACG, the International Vitamin A Consultative Group, is now recommending that, in areas where vitamin A deficiency is a public health problem, all new mothers receive 400,000 IU, split between two doses given at least one day apart, within 6 weeks of delivery. Although the effect of these increases is yet to be ascertained, evidence suggests they will be safe and effective. Internationally agreed upon postpartum supplementation guidelines could therefore be reviewed and updated in the coming months.

Effects of alternative maternal micronutrient supplements on low birth weight in rural Nepal: double blind randomized community trial

Christian P et al. British Medical Journal. March, 2003

Every year, 250 million children are born with a weight < 2500 g. An estimated 90% of these low birth weight babies are born in the developing world. In developing countries, birth weight is closely associated with the health and survival of infants. The objective of this study was to assess the impact of alternative combinations of micronutrients given to pregnant women on birth size and risk of low birth weight. A total of 4926 rural Nepalese pregnant women (4130 live born infants) were enrolled in a double blind cluster-randomized controlled trial. 426 communities were randomized to five regimens in which pregnant women received daily supplements of vitamin A (1000 µg; control group), vitamin A+folic acid (400 µg), vitamin A+folic acid+iron (60 mg), vitamin A+folic acid+iron+zinc (30 mg), or multiple micronutrients (including all of the above and more).

Results: Supplementation with folic acid had no significant positive effect on birth size when compared to the control group. Folic acid+iron increased mean birth weight by 37 g (95% confidence interval: -16 to 90 g) and reduced the percentage of low birth weight babies (<2500 g) from 43% to 34% (16%; relative risk =0.84, 0.72-0.99). Folic acid+iron+zinc had no effect on birth size compared with controls. Multiple micronutrient supplementation increased mean birth weight by 64 g (12-115 g) and reduced the percentage of low birth weight babies by 14% (0.86; 0.74-0.99). None of the supplement combinations reduced the incidence of preterm births. Neither combination of supplements seemed to affect linear growth (length), although folic acid+iron and multiple micronutrients increased mean head and chest circumference of babies. In conclusion, antenatal folic acid+iron supplements modestly reduce the risk of low birth weight. Multiple micronutrients conferred no additional benefit over folic acid+iron in reducing this risk. The authors of the study conclude that micronutrients beyond the standard prenatal iron+folic acid combination should be added only if there is evidence of a health benefit.

**Impact of supplementing newborn infants with vitamin A on early infant mortality:
community based randomized trial in southern India**

By Rahmathullah L et al; British Medical Journal. August 2003.

The impact of vitamin A supplementation on child survival is clear in children aged 6 months or older. Data on the survival impact of vitamin A supplementation in early infancy are conflicting. The objective of this study was to assess the impact on mortality at age 6 months of supplementing newborn infants with vitamin A. The study was a community-based, randomized, double blind, placebo-controlled trial conducted in rural Tamil Nadu (India). A total of 11,619 newborn infants were allocated to receive 24,000 international units (IU) oral vitamin A or placebo on days 1 and 2 after birth.

Results: Supplementing newborn infants with vitamin A was associated with a 22-23% reduction in mortality during the first six months of life. Vitamin A had an impact on mortality between two weeks and three months after treatment, with no additional impact after three months. The impact of vitamin A on survival was limited to infants of low birth weight (31% of infants were born with a weight < 2,500 g). In this group, vitamin A reduced mortality at 6 months by 37%. In contrast, there was no effect of vitamin A on mortality among infants weighing 2,500 g or more at birth.

Conclusion: Supplementing newborn infants with vitamin A can significantly reduce early infant mortality, particularly among low birth weight infants the authors conclude.

Delivery of nutrition services in health systems in sub-Saharan Africa Opportunities in Burkina Faso, Mozambique, and Niger

By Hampshire RD et al; HKI-Africa Nutrition in Development Series N. 3. October 2003.

In sub-Saharan Africa, underweight and micronutrient deficiencies (vitamin A, iron, and zinc) account for an estimated 25% of the burden of disease. As the coverage of national health systems expands, increased opportunities exist to address the needs of children and women, the most vulnerable to these deficiencies, through high quality nutrition services. The objective of this review was to assess health providers' knowledge and practice with regard to essential nutrition services for women and children in Burkina Faso, Mozambique, and Niger in order to guide the development of a standard guide and tools to assess and monitor the quality of the nutrition services delivered through national health systems.

Findings: The three surveys reveal the extent of missed opportunities to deliver nutrition services during routine prenatal, postnatal, and child-care consultations for the prevention and treatment of highly prevalent nutritional deficiencies. A commitment to improving the quality of facility-based nutrition services is necessary to impact the health outcomes of women and children "covered" by national health systems. Rigorous assessment and monitoring of the quality of nutrition services should inform health program and policy development.

SUMMARY

By Lowell J. Fuglie

Ideally, good nutrition is assured by a varied diet rich in meat, root, grain, fruit and vegetable foods. In reality, for a majority of the world's population such variety in food is unaffordable or seasonally unavailable. Within the sahelien region of Africa, for example, the dry seasons are marked by a heavy reliance on the staples of rice, millet and sorghum; during these months, fruits and greens can be found only in a few irrigated garden plots, and in virtually every year the wet season is a lean period where food stores have been exhausted one to three months prior to the new harvest. Within this region, infants in the weaning stage are the most vulnerable to malnutrition since their food intake is heavily reliant on millet.

According to nutrition expert Prof. Mike Golden: "Much of the problem with nutrition is not the quantity of food but the quality of food. You need about 40 different nutrients to be healthy."

"Some 50 percent of Ethiopian children are stunted in height; they haven't been growing properly. In Africa as a whole, just under 40% of its children are chronically malnourished. ... This is due to a poor quality diet."

"If you have a poor diet it makes you less able to resist disease, so the diseases come more frequently and they last longer. And when you get over your diarrhea or respiratory chest infection or your coughing or cold, if you are on a poor diet you don't have the convalescence so you don't regain the weight you have lost. So you stutter from infection to infection."

"The chronically malnourished child not only has stunted physical development, it also has stunted mental development. This tends to be very long standing . . . (They do) worse at school, they have poorer work records, they are more likely to be imprisoned, they are more likely in this context to be child soldiers or prostitutes. The most dangerous African animal is a 12-year-old with a kalashnikov who would have been a malnourished child."

Prof. Gordon was interviewed during a visit to Ethiopia during the time of a severe famine. However, even in the Gambia where there is peace, a fairly good network of health clinics and child monitoring services and a national nutrition agency determining national nutrition policies, malnutrition is a big problem. A survey taken in 1998 found that, within the Lower River Division, 92% of children under five had moderate to severe anemia and 69% suffered from vitamin A deficiency. In the words of Dr. Isatou Semega-Jammeh, director of Gambia's National Nutrition Agency:

"The age group most affected by acute malnutrition is the group of children in the weaning period – children between 12-23 months old. For this group acute malnutrition is 18% . . . {and} chronic malnutrition (stunting) is 16.2%.

“Malnutrition causes a great deal of human suffering and is associated with more than half of all deaths of children worldwide (Pelletier, 1995). Malnutrition severely impacts on the socio-economic development of a nation because a work force that is stunted both mentally and physically may have a reduced work capacity. The interaction of poverty, poor health and poor nutrition has a multiplier effect on the general welfare of the population and also contributes significantly towards keeping a population in a downward trend of poverty and nutritional insecurity. Thus nutrition plays an important role in the reproduction of poverty from one generation to the next.”

To return to the interview with Prof. Gordon: “If a country in Africa really wants development, it has to put good food in the mouths of its babies. There is no other way to develop than to put good food in their mouths and build up the human resource of the country.”

According to “Engineering solutions to malnutrition,” GRAIN, March 2000: “Vitamin A deficiency (VAD) is one of the leading forms of micronutrient malnutrition in developing countries, ranking third after iron and iodine deficiency. Historically, severe vitamin A deficiency has been associated with blindness, particularly childhood blindness (approximately 1 million blind children live in Asia and 300,000 in Africa – WHO Fact Sheet No. 214, Feb. 1999). More recently, its role in helping to fight infections has come to light. Vitamin A helps prevent diseases such as diarrhea, respiratory ailments, tuberculosis, malaria and ear infections, and helps prevent transmission of HIV from mother to child, as well as reducing incidence of mortality among pregnant women. Africa has the highest prevalence of clinical VAD.

“The origins of vitamin A deficiency in childhood can be traced to poor vitamin A nutrition status of the mother during pregnancy and lactation, resulting in poor liver reserves of vitamin A in newborns and in the breast milk; and poor intake of foods rich in . . . vitamin A by the infant after weaning and thereafter.

“In 1998, WHO recommended that in areas where VAD is prevalent, women be provided with a high-dose vitamin A supplement in the early postpartum. Postpartum dosing improves maternal vitamin A status and increases the vitamin A content of breast milk.”

Current programs aimed at preventing or treating malnutrition depend on very expensive imported foods which are out of reach of poor beneficiaries if offered commercially, and are thus not sustainable in the long term. The World Declaration and the Plan of Action on Nutrition, adopted by 159 countries during the International Conference on Nutrition in 1992, states that strategies to combat micronutrient malnutrition should “ensure that sustainable food-based strategies are given the first priority, particularly for populations deficient in vitamin A and iron, favoring locally available foods and taking into account local food habits.”

B. A POSSIBLE HOME GARDENING SOLUTION TO MALNUTRITION

Home gardens focusing on the production of yellow and dark-green leafy vegetables increase the serum retinol concentrations of 2-5-y-old children in South Africa.

By Mieke Faber, Michael AS Phungula, Sonja L Venter, Muhammad A Dhansay, and AJ Spinnler Benadé

INTRODUCTION

Vitamin A deficiency continues to be a major health problem in developing countries and has far-reaching consequences on growth, development, and health, especially in children. The dietary intakes of economically and socially deprived communities in developing countries usually consist of plant-based staple foods, and fruit, vegetables, and animal products are seldom consumed, predisposing these communities to low vitamin A intakes. Although clinical vitamin A deficiency in South Africa is not a problem, as it is in some of the other sub-Saharan countries, 1 in 3 preschool children has a serum retinol concentration <0.7 mol/L, and children from rural areas are affected the most. Supplementation with high-dose capsules, food fortification, and food diversification strategies are used to combat vitamin A deficiency. Foods of animal origin are good sources of vitamin A, but they are often too expensive for poor households to afford. Local production of fruit and vegetables may potentially provide households with direct access to foods that are rich in provitamin A carotenoids. For example, in Bangladesh, locally produced fruit and vegetables that are rich in provitamin A provide a valuable contribution to vitamin A intake in communities where alternative dietary sources of vitamin A are scarce. Strategies focusing on food diversification aim to increase the production and availability of, access to, and subsequent consumption of foods that are rich in vitamin A and provitamin A carotenoids. Home-garden interventions are most effective when combined with promotional and educational interventions. The problem in many rural areas in South Africa, and probably in many other African countries, is a lack of infrastructure for the implementation and promotion of sustainable gardening programs that are aimed at addressing specific nutritional needs. To overcome this problem, we integrated a home-gardening program with a primary health care activity, namely, a community-based growth-monitoring system in a rural area in KwaZulu-Natal, South Africa. The aim of the gardening program was to address the vitamin A deficiency prevalent in the area by promoting the production and consumption at the household level of foods that are rich in provitamin A carotenoids. The community-based growth-monitoring system provided the infrastructure that was needed for relevant nutritional education, home-gardening promotion, and training in agricultural activities.

Background: Production of yellow and dark-green leafy vegetables at the household level may provide economically deprived households with direct access to provitamin A-rich foods.

Objective: The aim of the study was to determine whether the dietary intake of yellow and dark-green leafy vegetables and the serum retinol concentrations of children improve with a home gardening program.

Design: A home-gardening program was integrated with a community-based growth-monitoring system in a rural village. Cross-sectional data were collected at baseline and 20 mos after implementation of the program. The dietary intake, serum retinol concentrations, and growth of 2-5-y-old children and maternal knowledge regarding vitamin A were determined. A neighboring village served as a control village.

Results: In the experimental village, 126 home gardens were established, representing approximately one-third of the households. Serum retinol concentrations in the experimental village increased significantly ($P = 0.0078$), whereas those in the control village decreased significantly ($P = 0.0148$). At follow-up, children from the experimental village consumed yellow and dark-green leafy vegetables more often and had significantly higher ($P = 0.005$) serum retinol concentrations ($0.81 \pm 0.22 \mu\text{mol/L}$; $n = 110$) than did children from the control village ($0.73 \pm 0.19 \mu\text{mol/L}$; $n = 111$). Maternal knowledge regarding vitamin A improved significantly in the experimental village ($P = 0.001$).

Conclusion: A home-gardening program that was integrated with a primary health care activity, linked to nutrition education, and focused on the production of yellow and dark-green leafy vegetables significantly improved the vitamin A status of 2-5 year-old children in a rural village in South Africa.

Bioavailability trials of beta-carotene from fresh and dehydrated drumstick leaves (*Moringa oleifera*) in a rat model.

Bu Nambiar VS, Seshadri S.

Department of Foods and Nutrition, Faculty of Home Science, MS University of Baroda, Vadodara, Gujarat, India.

Male albino rats (Charles Foster, n = 40) were fed a synthetic diet deficient in vitamin A for 4 weeks. Six rats died during the depletion period. Of the 34 surviving, 5 rats were continued on the vitamin A deficient diet for 4 more weeks and 24 were repleted with vitamin A (4000 IU/kg diet) in the form of vitamin A acetate (group A, n = 8), fresh drumstick leaves (group B, n = 8) or dehydrated drumstick leaves (group C, n = 8) for 4 weeks. The remaining 10 rats were continued on the vitamin A adequate diet for 4 (n = 5) and 8 weeks, respectively (n = 5). A marked reduction in food intake, body weight, accompanied by clinical signs of vitamin A deficiency and a decline in serum vitamin A (29.2 to 19.1 microg/dL) and liver vitamin A (3.7 to 2.0 microg/dL) were seen at the end of 4 weeks of feeding a vitamin A deficient diet. On repletion significant improvements in clinical signs, food intake and body weights were noted in the three groups compared to the baseline (n = 5) and at the end of 4 weeks of depletion. The gain in body weight was highest for the group repleted with dehydrated drumstick leaves. Among the repleted groups, the serum vitamin A was highest for group A (34.7 microg/dL) given synthetic vitamin A, compared to group B (25.8 microg/dL) and group C (28.2 microg/dL) given drumstick leaves. All these were significantly higher than the serum vitamin A values seen at the end of 4 weeks of depletion (19.1 microg/dL). A significant improvement was also observed in the liver retinol levels on repletion for 4 weeks in the three groups, compared to the vitamin A depleted rats. These results imply that beta-carotene from drumstick leaves was effective in overcoming vitamin A deficiency although serum vitamin A levels remained somewhat lower compared to the group repleted with vitamin A acetate. In terms of growth parameters, the fresh and dehydrated drumstick leaves were better than the synthetic vitamin A. It is therefore concluded that in the developing countries like India, sources of vitamin A such as drumstick leaves are valuable in overcoming the problem of vitamin A deficiency.

Energy and micronutrient composition of dietary and medicinal wild plants consumed during drought. Study of rural Fulani, northeastern Nigeria.

By Lockett CT, Calvert CC, Grivetti LE.

Department of Nutrition, University of California, Davis 95616, USA.

Two rural settled Fulani villages, northeastern Nigeria, were surveyed for dietary practices and use of edible wild plants (n = 100 households). Commonly consumed species of edible wild barks, fruits, leaves, nuts, seeds, and tubers were analyzed for protein, fat, and carbohydrate and for minerals. Kuka bark (*Adansonia digitata*) given to infants to increase weight gain was high in fat, calcium, copper, iron, and zinc. Cediya (*Ficus thonningii*), dorowa (*Parkia biglobosa*) and zogale (*Moringa oleifera*) were good sources of protein and fat and excellent sources of calcium and iron or copper and zinc. Fruits, leaves, and nuts of aduwa (*Balanites aegyptiaca*) were widely used during the dry season and during drought. Edible wild species available during the wet season generally were inferior in energy and micronutrient mineral content compared to dry season plants. Fruits commonly eaten by children were poor sources of protein and minerals but rich in carbohydrate and fiber. Tsamiya seeds (*Tamarindus indica*) were good sources of zinc and used to make dawwa (porridge) commonly consumed during pregnancy. Kirya seeds (*Prosopis africana*) contained the highest zinc concentrations. Shiwaka leaves (*Veronica colorata*) consumed by pregnant women to increase breastmilk production and to expel intestinal worms, were high in fiber, phosphorus, magnesium, manganese, and were adequate sources of calcium.

Promoting the “miracle tree of hope”

By Haile-Gebriel Endeshaw
Ethiopian Herald, 19 July 2003

“This workshop shouldn’t be concluded like most other workshops by merely presenting study papers. We all should come to a common agreement on how to transfer the value of the tree from research to better services.”

“A decade ago researchers speculated that 20 years after, the torrential rains that have been falling in the high land areas would wash away the soil and fill Zeway Lake located here below. Mind you, it was just a speculation! Now ten years later, the prediction holds. Being filled by silts, the lake is retreating. We all can see this with our naked eyes.”

The General Manager of TEPPA Agricultural and Trade Plc, Ato Kibre-Ab Abebe said the forgoing at a workshop held last week in Meki town on the Promotion of Moringa (*stenopetala*) tree. Kibre-Ab was talking about the retreating Zeway Lake located in Dugdabora Woreda, East Shewa Zone of Oromia State.

Kibre-Ab went on saying that the alluvial soil that is being carried to the lake wouldn’t stop unless something is done to curb the erosion in the high land area. “There is nothing at the moment that stops the running flood in the area. Therefore, we all should come up with something to prevent this,” Kibre-Ab strongly urged workshop participants.

Mek is a small town located 134 kms from here, on the Addis-Awassa main road. The workshop organized by TEPPA Agricultural and Trade Plc was attended by invited researchers and individuals representing governmental as well as non-governmental organizations, religious and private institutions.

A researcher from the Ethiopian Agricultural Research Organization (EARO), Ato Dechasa Jiru said while briefing the workshop participants about his experience in Wollega area of Oromia State. People in this part of the country are heard complaining about the ever-increasing colony of termites (white ants) that is doing a lot of damage in the area, according to Dechasa.

“The reason for this is that the natural predator of the termites is no more in existence in the area. Why? Because it had been made homeless. Its home, the forest, has been destroyed. The lion, the king of the jungle, has two enemies: termites and fire. The colony of termites that, fortunately for it, is left free of a predator, chased away the lion from that part of our country! Now, look how nature is losing its balance. All this devastation is happening due to the ever increasing loss of our forest resource,” Dechasa said.

Both Kibre-Ab and Dechasa strongly share the very urgent need for replenishing the diminishing forest resources of the country. They underscored that the promotion of *Moringa stenopetala* tree would help rehabilitate the forest resource. *Moringa* tree, more

familiarly known as *Shiferaw* or *Haleko* across the country, can be taken as a cure to the drought related maladies in the country, according to them.

It was indicated during the course of the discussion that *Moringa* tree has nutritional and medicinal values at the same time. Ato Dechasa said that some 50 percent of the people in Konso Special Woreda of the Southern Nation, Nationalities and Peoples State (SNNPS) get their food from *Moringa* or *Haleko* tree. Dechasa said that *Haleko* is a favourite main component of the daily meal of the Konso and other people in southern Ethiopia. Its common name “Cabbage tree” has been derived from the dietary role its leaves play. Apart from being consumed as a vegetable, it is also marketed as a source of income in a local market, according to Dechasa.

Ato Simon Shiburu of the Institute of Biodiversity Conservation and Research said that *Haleko* (*Moringa stenopetala*) is one of the forgotten tree species in the country. He said that its multi-purpose nature has earned *Haleko* the name of a “miracle tree of hope”. “I know this tree closely as I grew up by consuming its leaves and flowers. This is because I was born and brought up in localities where *Haleko* tree is widely known,” Simon said.

According to Simon, peoples in Southern Ethiopia feed on the leaves of *Haleko* tree throughout the year by cooking it like cabbage. Its flowers can also be eaten anytime, he said. Simon further noted that various parts of *Haleko* tree were proved to have disease preventing chemicals inside them. “Many people with high blood pressure boil the leaves and drink the water to get relief from their ailment. The medicinal value of *Haleko* tree is much weightier than its nutritional usage in some nationalities, especially in Konso and Derashie,” said Simon.

Speaking of the social value of *Haleko* tree, Simon said that the status of an individual is in direct proportion with the number of *Haleko* trees they have at their backyard. “When a boy proposes marriage in some parts of the south, the girl’s family enquire whether or not the would-be groom has *Haleko* trees in his farm,” Simon said.

Simon said that despite the enormous economical and social value *Haleko* has in the Ethiopian society, it has been given insignificant attention even in localities where it is widely known. It hasn’t been given due care, according to him. “If people in both rural and urban areas grow *Haleko* in their respective localities, it will play the multiple roles of assisting farmers economy and health and help replenish the ever diminishing forest resource of the country. *Haleko* tree grows in elevations as high as 2,200 m and as low as 300 m in Ethiopia.”

According to Dr. Alemtsehai Mekonnen of the Addis Ababa University, a study conducted on the plant in Arba-Minch area of SNNPS revealed that for years, people have been using *Haleko* tree as supplementary food and medicine.

People who had been interviewed for the study indicated that they drink the juice of the ground (smashed) root of the tree to get relief from their malaria sickness, according to Dr. Alemtsehai. “Laboratory studies also revealed that *Haleko* (*Moringa stenopetala*) has

low Toxicity power. There is also a hypothesis that the seed of the tree has the capacity of ‘sucking’ the fluorine content in drinking water,” she said.

The spirit of the discussion was that something should be done to promote this ‘miracle tree of hope’. Ato Kibre-Ab Abebe, the General Manager of TEPPO Agricultural and Trade Plc said during the course of the discussion that his company organized the workshop with the major objective of promoting the multiple purpose tree. “This workshop shouldn’t be concluded like most other workshops by merely presenting study papers. We all should come to a common agreement on how to transfer the value of the tree from research to better services,” he said.

In the end, the workshop participants unanimously agreed to form an interim committee that would deal with the promotion of *Moringa* tree in the country, and did so right away.

The newly established *Moringa tree Promotion Committee* comprises members drawn from the federal Ministry of Agriculture, Addis Ababa University, Institute of Biodiversity Conservation and Research, Ethiopian Agricultural Research Organization, Oromia Agricultural Research Bureau, Dugdabora Woreda Administration, World Vision – Ethiopia and International Livestock Research Institute.

TEPPO Agricultural and Trade Plc had reportedly raised seedlings of *Haleko* tree (*Moringa*) which it distributed to peasants of 10 kebeles in Dugdabora Woreda, East Shewa Zone of Oromia State.

MORINGA OLEIFERA

NUTRITIONAL VALUE OF LEAVES AND PODS

Analysis of Moringa pods, fresh (raw) leaves and dried leaf powder has shown them to contain the following per 100 grams of edible portion.

| | <u>PODS</u> | <u>LEAVES</u> | <u>LEAF POWDER</u> |
|------------------------------------|-------------|---------------|--------------------|
| Moisture (%) | 86.9 | 75.0 | 7.5 |
| Calories | 26.0 | 92.0 | 205.0 |
| Protein (g) | 2.5 | 6.7 | 27.1 |
| Fat (g) | 0.1 | 1.7 | 2.3 |
| Carbohydrate (g) | 3.7 | 13.4 | 38.2 |
| Fiber (g) | 4.8 | 0.9 | 19.2 |
| Minerals (g) | 2.0 | 2.3 | - |
| Ca (mg) | 30.0 | 440.0 | 2.003 |
| Mg (mg) | 24.0 | 24.0 | 368.0 |
| P (mg) | 110.0 | 70.0 | 204.0 |
| K (mg) | 259.0 | 259.0 | 1.324 |
| Cu (mg) | 3.1 | 1.1 | 0.57 |
| Fe (mg) | 5.3 | 7.0 | 28.2 |
| S (mg) | 137.0 | 137.0 | 870.0 |
| Oxalic acid (mg) | 10.0 | 101.0 | 1.6% |
| Vitamin A - B carotene (mg) | 0.11 | 6.8 | 16.3 |
| Vitamin B -choline (mg) | 423.0 | 423.0 | - |
| Vitamin B1 -thiamin (mg) | 0.05 | 0.21 | 2.64 |
| Vitamin B2 -riboflavin (mg) | 0.07 | 0.05 | 20.5 |
| Vitamin B3 -nicotinic acid (mg) | 0.2 | 0.8 | 8.2 |
| Vitamin C -ascorbic acid (mg) | 120.0 | 220.0 | 17.3 |
| Vitamin E -tocopherol acetate (mg) | - | - | 113.0 |
| Arginine (g/16g N) | 3.6 | 6.0 | 1.33% |
| Histidine (g/16g N) | 1.1 | 2.1 | 0.61% |
| Lysine (g/16g N) | 1.5 | 4.3 | 1.32% |
| Tryptophan (g/16g N) | 0.8 | 1.9 | 0.43% |
| Phenylalanine (g/16g N) | 4.3 | 6.4 | 1.39% |
| Methionine (g/16g N) | 1.4 | 2.0 | 0.35% |
| Threonine (g/16g N) | 3.9 | 4.9 | 1.19% |
| Leucine (g/16g N) | 6.5 | 9.3 | 1.95% |
| Isoleucine (g/16g N) | 4.4 | 6.3 | 0.83% |
| Valine (g/16g N) | 5.4 | 7.1 | 1.06% |

Many of the above vitamins, minerals and amino acids are very important for a healthy diet. An individual needs sufficient levels of certain vitamins, minerals, proteins and other nutrients for his physical development and well-being. A deficiency of any one of these nutrients can lead to health problems. Some of the problems caused by deficient diets are well known: scurvy, caused by lack of vitamin C; night blindness, caused by lack of vitamin A; kwashiorkor, caused by lack of protein; anemia, caused by lack of iron. Many other health problems are caused by lack of vitamins or minerals which are less known, but still essential to a person's bodily functions.

Actual need for different vitamins, etc., will vary depending on an individual's metabolism, age, sex, occupation and where he/she is living. Actual bioavailability of the vitamins and minerals present in Moringa leaves will vary. For example, the iron content of plants absorbed by the body during digestion may be low.

Recognizing the nutritional value of Moringa

From: http://www.treesforlife.org/moringa/more_nutr_experts.htm

"Green leafy vegetables and fruits supply much needed essential micronutrients like beta-carotene [vitamin A], vitamin C, folic acid, and also calcium and potassium. Moringa leaves in particular are a rich, inexpensive source of micronutrients."

- Dr. C. Gopalan, President, Nutrition Foundation of India

"Among the wide range of Green Leafy Vegetables, Moringa is the richest source of Beta-Carotene [vitamin A], apart from providing other important micronutrients. Small amounts of less than 10 gm of fresh Moringa leaves would meet the day's requirement of Beta-Carotene of preschool children."

- Dr. Kamala Krishnaswamy, Director, National Institute of Nutrition, India

"As a source of nutrients and vitamins, Moringa leaves rank among the best of perennial tropical vegetables. It has been estimated that one glassful of fresh Moringa leaves contain the daily requirement of vitamin A for up to ten people, and adding two raw Moringa leaves to children's daily food intake, or mixing 2-3 teaspoons of dried Moringa leaf powder into other sauces living in high-risk areas."

- Church World Service

"Among the leafy vegetables, one stands out as particularly good, the horseradish [Moringa] tree. The leaves are outstanding as a source of vitamin A and, when raw, vitamin C. They are a good source of B vitamins and among the best plant sources of minerals. The calcium content is very high for a plant. Phosphorous is low, as it should be. The content of iron is very good (it is reportedly prescribed for anemia in the Philippines). They are an excellent source of protein and a very low source of fat and carbohydrates. Thus the leaves are one of the best plant foods that can be found."

- Dr. Frank L. Martin, in *Survival and Subsistence in the Tropics*

The Moringa Tree: Nature's Pharmacy

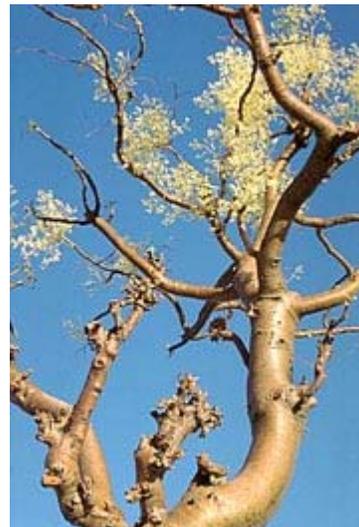
By [Aisha El-Awady](#)

20/02/2003

The resilient, fast growing Moringa tree is packed with so many vitamins and nutrients and has such a high nutritional value that it has been rightly dubbed by some as the miracle tree.

The Miracle Tree

All parts of this scruffy looking tree are edible; the leaves can be eaten raw, cooked like spinach or made into a powder that can be added to sauces, soups or chowders. The new leaves have a tendency to appear towards the end of the dry season when few other sources of green leafy vegetables are available. The young, green pods can be eaten whole and are comparable in taste to asparagus. The older pods can be used for their seeds, which can be prepared as peas or roasted and eaten like peanuts. The flowers which bloom around 8 months after the tree is planted, can be eaten fried and have the taste and texture of mushrooms. In Hawaii, the flowers are used to make a tea that cures colds. In addition to this, the flowers are a year- round source of nectar and can be used by beekeepers.



Moringa tree

When the pods mature and turn brown, the seeds can be removed and pressed to extract high quality oil similar to olive oil rich in oleic acid (73%). The mature seed contains about 40% oil. The oil, which is known as Ben oil, can be used for cooking, lubrication, in soaps, lamps and perfumes. The oil was highly valued by ancient Greeks, Romans and Egyptians and was used in perfumes and for skin protection; it was also used in Europe in the 19th century for the same purpose and was imported from the West Indies. The taproot of young trees can be used to make a spice resembling horseradish when vinegar and salt are added to it.

Not only is the Moringa oleifera tree extraordinary in that all parts of the tree are edible, but the most amazing aspect of the tree is its exceptionally high nutritional value. The leaves of the Moringa tree are an excellent source of vitamin A (four times the amount in carrots), the raw leaves are rich in vitamin C (seven times the amount in oranges), and they are also a good source of vitamin B and other minerals. The leaves are also an outstanding source of calcium (four times the amount in milk), protein (twice the amount in milk), and potassium (three time the amount in bananas). The content of iron is very good as well and the leaves have purportedly been used for treating anemia in the Philippines. The content of amino acids such as methionine and cystine is also high. Carbohydrates, fats and phosphorous content are low making this one of the finest plant foods to be found.

Africa's Solution to Malnutrition?

These qualities have made the *Moringa oleifera* tree a candidate in the fight against malnutrition. A group of health workers from the Church World Service have been utilizing this highly nutritious and fast growing tree as a means to cure and prevent malnutrition in infants, pregnant and lactating women as an alternative to the classic and expensive condiments usually used such as whole milk powder, sugar, vegetable oil, and sometimes peanut butter. It takes around ten days to see an improvement in malnourished infants when Moringa leaves are used whereas it takes months for recovery with conventional methods.

According to Dr. Lowell Fuglie, the West Africa representative of the Church World Service who used the Moringa tree as a base for a nutrition program, "for a child aged 1-3, a 100 g serving of fresh cooked leaves would provide all his daily requirements of calcium, about 75% of his iron and half his protein needs, as well as important amounts of potassium, B vitamins, copper and all the essential amino acids. As little as 20 grams of leaves would provide a child with all the vitamins A and C he needs."

"For pregnant and breast-feeding women, Moringa leaves and pods can do much to preserve the mother's health and pass on strength to the fetus or nursing child. One 100 g portion of leaves could provide a woman with over a third of her daily need of calcium and give her important quantities of iron, protein, copper, sulfur and B-vitamins."

"One rounded tablespoon (8 g) of leaf powder will satisfy about 14% of the protein, 40% of the calcium, and 23% of the iron and nearly all the vitamin A needs for a child aged 1-3. Six rounded spoonfuls of leaf powder will satisfy nearly all of a woman's daily iron and calcium needs during pregnancy and breast-feeding."



Moringa oleifera flowers

Water Purification

▲ The Moringa tree has other extraordinary qualities; the powder from ground Moringa seeds and the presscake left over from oil extraction have the ability to clear murky water as it acts as a coagulant which attaches to particulate matter and bacteria in the water and falls to the bottom of the container. The purified water can then be poured out and boiled. This method has been used for centuries domestically and has recently been tried commercially and was found to be equally efficient to, if not surpassing, alum which is usually used and at a fraction of the cost.



Left - whole seed and seed powder; right - presscake remaining following oil extraction

Practical Uses

The bark of the tree can be used to make mats or rope and in tanning hides. The gum from the cut tree trunks is used in calico printing and in some medicines. The wood can be used to make a blue dye and can also be used as firewood. The flowers and roots of Moringa trees contain a powerful antibiotic known as pterygospermin, which also has fungicidal properties. An effective plant growth hormone can be extracted from fresh leaves and has been found to increase crop yields by up to 25-30%, and the leaves can also be used as a green manure to enrich farmlands.

Mother's Best Friend

The family Moringaceae contains 14 species of Moringa trees. *Moringa oleifera*, is a drought tolerant tree, and is the best-known member of this family. It is native to sub-Himalayan regions of northern India and is distributed all over the world in tropics and sub tropics. *Moringa stenopetala*, which produces larger seed and leaves than *M. oleifera*, inhabits Ethiopia and northern Kenya. *M. peregrina* is native in Egypt, Sudan, and the Arabian Peninsula and as far north as the Dead Sea. *M. ovalifolia* is found in Angola and Namibia.

The tree has many different names. It is called the drumstick tree in India due to the long pods, or the horseradish tree as the roots may be used to make a spice resembling horseradish. In some parts of the world it is known as 'Mother's best friend'. In Senegal, it is known as Nebeday, which means "Never Die," because the tree is outstandingly hearty. It is also known as the Ben Oil tree; the Benzolive tree in Haiti; Marum in Thailand; Yoruba in Nigeria and Malunggay in the Philippines.

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Health & Science

The obstacles to Moringa promotion

Since Moringa already exists and used in many African countries (see Section C below for a list of vernacular names), it is not difficult to promote added uses of the tree. However, for Moringa to be acceptable for use as a component of national and international nutrition programs, additional studies are needed to confirm its effectiveness and safety.

Looking through the internet, one can find up to 100 published papers on Moringa. However, the majority of these are either analyses of nutrient content, or laboratory tests using healthy rats/mice for short periods of time. There are practically no randomized, double-blind placebo controlled trials of human subjects that document the effectiveness of Moringa powder over a long period of time. Such a study would normally require ethical clearance by an ethical review committee, and strict supervision by medical staff. Two studies have been done, one in Senegal giving daily doses of Moringa leaf powder to lactating mothers, implemented by the Nutrition Department of Cheikh Anta Diop University with support from Church World Service; and a similar study in Mauritania implemented by World Vision. Although both studies measured absorption of iron and vitamin A, a long-term study is still needed. Such a study, planned to be implemented over a period of three years, is presently underway in The Gambia. This study is being implemented by the National Nutrition Agency with support from Church World Service. It is hoped that similar studies will be conducted by respected institutions in other countries.

The laboratory reports done on Moringa's toxicity and nutritional composition are sound: they do not find evidence of any inherent toxins. In addition to several studies done in India, a study entitled "Toxicological and Some Pharmacological Assessment of Moringa Dried Leaf Powder," sponsored by CWS, was conducted by the Noguchi Memorial Institute for Medical Research, located in Ghana, in mid-2002. This study determined that ". . . Moringa powder (is) practically non-toxic according to the classification of relative toxicity of chemical substances (Echobicon, 1990)." But, a) that does not in itself rule out potential negative effects of consumption by malnourished infants, nor b) does it assess the bioavailability of the many nutrients contained. The fact that beta-carotene exists in a plant does not mean that it can be converted into vitamin A by the consumer. Bioavailability may be constrained by a host of factors relating to the form of the micronutrient, potential inhibitors in the same plant or elsewhere in the diet, or indeed to a lack of enabling nutrients (perhaps a lack of fat consumption by malnourished infants, when fat is needed for adequate vitamin A absorption).

Studies in favor of Moringa promotion

Many of the questions raised by experts in the field of nutrition and Moringa's potential are addressed by Dr. Monica G. Marcu, Pharm. D., P.D., in her recently published book "Miracle Tree" (KOS Health Publications, 466 Foothill Blvd. #251, La Canada, CA. 91011. April 2005), in which Dr. Marcu provides a very detailed look at Moringa's nutritional content, safety and bioavailability. To quote from this book:

P.2: "Of all the Moringa tree's parts, the bark is the only part that can be toxic for human consumption."

P.3: "Absolutely no negative effects to daily consumption of Moringa leaves and seeds have ever been reported."

P.16: "Vitamins are complex substances vitally important for metabolic and many other physiological reactions. . . 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."

P. 20: A diet rich in plants such as Moringa can significantly improve human health by:

- Reducing cholesterol levels and triglycerides ("bad" fats in the serum).
- Controlling blood sugar and helping normal sugar and energy balance.
- Offering vitamins and minerals vital for maintaining normal physiology.
- Offering powerful antiaging and anti-inflammatory natural substances, many with anticancer properties.

P.25: "Generally, vitamins and most minerals are best absorbed and used by the body when they come from natural sources (plants, animals) and are present in natural, complex combinations."

P. 27: "In terms of protein value, the Moringa leaves are about 40% protein, with all of the 9 essential amino acids present in various amounts. (Essential acids are those that the body cannot synthesize, therefore they must be supplied by the diet). Moringa is considered to have the highest protein ratio of any plant so far studied on earth!"

P. 28: "Calcium is a vital macroelement for human health. A cup (8 ounces) of milk or yogurt could supply 300-400 mg (about half of the daily necessary amount), while 8 ounces of Moringa leaves contain 1,000 mg calcium. Moringa leaf powder of the same weight (8 ounces) contains over 4,000 mg calcium."

P. 28: “Moringa is very high in iron. Three ounces (about 100 g) contain 7 mg of iron, while the leaf powder has 28 mg. One of the richest iron sources, roast beef, has only 2 mg iron proportionally per three ounces.”

P. 28: Vitamin C, one of the most disputed, talked about and supplemented vitamins, is found in Moringa in large quantities. 100 g of Moringa leaves contain more than 200 mg vitamin C, while 100 g of orange juice has only about 40 mg.”

P. 33: “Moringa essential amino acids presence and digestibility scores are more than adequate when measured against the standards of 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 soy beans, one of the best known and most valuable plant sources of proteins, Moringa’s leaves fare great. 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.”

P. 57: “Moringa contains significant amounts of microelements such as iron, zinc, copper, manganese and selenium.

“Iron

. . . Moringa has much more iron than spinach. 100 g of leaves of pods, or 25 g (less than an ounce) of leaf powder could provide all the daily 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 USA.

“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. . . Since Moringa contains high amounts of vitamin C. . ., it represents an excellent source of absorbable iron.”

P. 59: “Zinc, similar to iron, is found in a variety of foods, in different quantities, with different degrees of absorbability. Moringa leaves, pods and seeds contain zinc in amounts similar to those found in beans, while the leaf powder has twice as much zinc per the same weight.”

P. 60: “. . . copper is also found in Moringa. One hundred grams of leaves provide enough copper for the daily allowance in an adult (about 1 mg).”

P. 61: “The estimated adequate dietary intake for manganese is 2-5 mg for adults. Moringa has 5 mg per 100 g or 50 g leaf powder, and thus qualifies as an outstanding source of manganese.”

P. 62: “The daily selenium need for adults is 50-70 mcg (micrograms; one mcg represents one thousandth of a mg). Vegetal foods (fruits and vegetables) generally provide little selenium, but Moringa contains about 8-10 mcg per 100 g leaf powder.”

P. 65: “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 absolutely essential fats or 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.”

Pp. 74-75: “. . . 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, roots, sprouts, 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.”

P. 78: “Moringa is an excellent source of vitamins from the B complex group.”

Pp. 85-88: “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.

“Moringa contains extremely rich amounts of vitamin A in its plant form – provitamin A or beta-carotene. Beta-carotene is the molecule that gives carrots their orange color.

“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 of plants containing provitamin A as beta-carotene. 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 possibly existent 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 in 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.

“. . . Moringa leaves have more beta-carotene than the carrot, famous precisely for its content of beta-carotene!”

Pp. 100-101: “Moringa is very rich in beta-sitosterol and related substances, and this is another excellent reason to include it in your diet. . . It is believed that the average American diet lacks this component, since it generally includes few veggies.

“. . . 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.
- It has anti-inflammatory properties.
- It helps normalize the blood sugar and supports the pancreas (which produces insulin – the hormone controlling blood sugar).
- It helps to heal ulcers.
- It can alleviate cramps.”

P. 103: “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 amount, all the calcium and vitamin A, a quarter of vitamin C and three quarters of iron needed daily!”

Pp. 108-115: “Various experiments have shown that cytokinins like zeatin or kinetin have potent antiaging and protective effects in animals (including humans), similar to their activity in plants.

“Studies have shown that zeatin administered to mice can effectively protect them against memory and brain performance loss triggered by amyloids and chemical agents. . . Further studies are ongoing to clarify the importance of zeatin supplements for delaying brain aging.

“Zeatin is found in many, if not most, superior plants. . . Of course, many plants have not been tested yet for zeatin concentrations, but for those tested, the zeatin amounts vary between .0002 mcg/g material to .02 mcg/g. The zeatin concentration in Moringa leaves gathered from various parts of the world was found to be very high, between 5 mcg and 200 mcg/g 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.”

P. 120: **ANTIOXIDANTS 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 (pro-vitamin 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.”

P. 124:

- **“Normal biochemical reactions inside our bodies create unstable molecules = free radicals.**
- **Free radicals steal electrons from other molecules, in this process damaging them and creating new free radicals.**
- **Every day, every cell is hit by numerous free radicals.**
- **Antioxidants donate electrons to the electron-starved free radicals, thus rendering them tame and stable.**
- **The more antioxidants in our bodies, the less cellular damage and diseases.**
- **Antioxidants work better in complex combinations with other antioxidants.**
- **Plants are the main and richest source of antioxidants for humans.”**

Pp 141-106: (SUMMARY)

“*Moringa oleifera* is extremely rich in vital nutrients and, as a bonus, can grow very fast 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. And eyes... from blindness due to lack of vital nutrients such as vitamin A in the diet. 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.

“... science continues to validate the ancient traditional therapeutic uses of Moringa. Recently, novel derivatives of thiocarbamates and nitriles which stimulate insulin release in animals have been found in Moringa. These compounds and their action explain the anti-diabetic properties of the Miracle Tree. The list with valuable, recent medicinal discoveries related to Moringa goes on and on. One would need hundreds of pages to mention all the discoveries and describe their content.

“Now that you understand better the value of this plant to us, you might consider as justified all those suggestive, affectionate names people gave Moringa: “Miracle Tree,” “Mother’s Best Friend,” and “Never Die.”

The advantages of using Moringa in malnutrition prevention programs

By Lowell J. Fuglie

In the African context, Moringa is a very simple and readily available tool to help prevent malnutrition. It is a drought-resistant and fast growing tree which is present in nearly all tropical and sub-tropical countries (see page 32 for names of Moringa in West African countries). Its edible leaves are already an occasional food source in West Africa regions and appear at the end of the dry season: a time when other greens are in short supply. As a source of good nutrition, its leaves are considered the best of tropical legumes with its high quantities of vitamin A and significant quantities of vitamin C, calcium, iron, protein, potassium, magnesium, selenium, zinc and a good balance of all the essential amino acids. Also, the leaves can be easily dried into powder form for use as a nutritional supplement for sauces or as an addition to infant weaning foods.

Moringa leaves can be produced intensively in a family-size small garden. The seeds can be spaced as closely as ten centimeters apart. When the plants reach a height of a meter, they can be cut down to a height of 30 centimeters. The leaves can be stripped from the stems and used to prepared sauces or dried for long-term storage as a nutritious food additive, and the stems fed to livestock. The stumps survive the harvest and will re-sprout, allowing another harvest in as little as fifty days. Using this technique, a Moringa garden can continually produce green matter for several years with very little labor required.

The many additional benefits of Moringa

Moringa's leaves, flowers, bark, wood and roots are used worldwide for a large variety of medicinal purposes. But there are also many other uses for the tree. Among these:

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

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

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

Fencing: A common use of Moringa trees is as a living support for fencing around gardens and yards.

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

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

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

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

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

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

Ornamental: In many countries, Moringa trees are planted in gardens and along avenues as ornamental trees.

Plant disease prevention: Incorporating Moringa leaves into the soil before planting can prevent damping off disease (*Pythium debaryanum*) among seedlings.

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

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

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

Water purification: Powdered seed kernels act as a natural flocculent, able to clarify even the most turbid water.

C: VERNACULAR NAMES FOR MORINGA OLEIFERA IN AFRICA

BENIN

(Bariba): Yuru ara, Yorwata, Yoroguma.

(Dendi): Windibudu.

(Fon): Patima, Kpatima, Yovokpatin, Kpano, Yovotin.

(Natemba): Tekpinda.

(Peul): Guildandeni, Latj iri, Legi-lakili.

(Waama): Yori kununfa.

(Yoruba): Ewé ilé.

(Yoruba-Nago): Ewé igbale, Ewé ile, Ewé oyibo, Agun, Ayere, Manyieninu, Oyibo.

BURKINA FASO

(Fulfuldé): Guilgandani, Gigandjah.

(Moré): Argentiga, Alsam tiga (“The tree of paradise”).

CAMEROUN

(Daggai): Paizlava.

(Foulfoudé): Guiligandja.

(Mafa): Gagawandalahai.

(Mandara): Djihiré

(Moundang): Naa-toukoré.

(Pokoko): Chabané.

(Toupouri): Naa-nko.

CHAD

(Sara): Kag n’dongue.

ETHIOPIA

(In Konsoigna): Shalchada, Shelagda.

(In Giddigna): Aleko, Haleko.

(In Amharigna): Sheiferaw.

GHANA

(Ewe): Yevu-ti, Babatsi.

(Dagari): Zangala, Obnyukuo (ob = chew; nyu = drink; kuo = water).

(Hausa): Zingeridende.

KENYA

(Swahili): Mkimbo, Mlonge, Mlongo, Mronge, Mrongo, Mzunze, Mzungu.

MALAWI

(Chichewa): Cham’wanba, Kanganuni.

(Senna): Nsangoa.

(Yao): Kalokola

Also: Maula tengo, Mpundi, Muula, Mbula, Mpempu, Chakate, Mpenba.

MALI

(Bambara): Névrédé.

NIGER

(Hausa): Zôgala gandi.

(Zarma): Windi-bundu.

NIGERIA

(Fulani): Gawara, Konamarade, Rini maka, Habiwal hausa.

(Hausa): Zogall, Zogalla-gandi, Bagaruwar maka, Bagaruwar masar, Shipka hali, Shuka halinka, Barambo, Koraukin zaila, Rimin turawa, Rimin nacara.

(Ibo): Ikwe oyibo.

(Yoruba): Ewe ile, Ewe igbale, Idagbo monoye (“the tree which grows crazily”).

SENEGAL

(Diola): Binêbeddai.

(Mandingue): Névrédayo, Nédèdayo

(Pulaar): Nebôday, Sap-Sap.

(Serere): Nébédai, Sap-Sap.

(Wolof): Nobodai, Névoidai, Nébédai, Sap-Sap.

SOMALIA

Dangap

SUDAN

(Arabic): Ruwag, Alim, Halim, Shagara al ruwag (“the tree for purifying”).

TANZANIA

(Swahili): Mlonge

TOGO

(Dagomba): Baganlua, Bagaelean.

(Ewe): Kpotima, Yevu-ti.

(Mina): Yovovoti.

(Moba): Gambaduk.

ZIMBABWE

(Tonga): Mupulanga, Zakalanda.