

Clinical Perspectives on the Health Effects of *Moringa oleifera*: A Promising Adjunct for Balanced Nutrition and Better Health

by Brett C. Johnson, B.Pharm., M.B.A.

Moringa oleifera, known for centuries by developing nations as an important nutritional supplement with a variety of medicinal properties, has recently been made available as Zija™, the first commercially-promoted *Moringa oleifera*-containing product sold in the U.S. Unlike other nutritional supplements, Zija provides very low-calorie, quality protein dietary supplementation (containing 19 of the 20 most common amino acids). In addition, Zija shows considerable promise as a lower-carbohydrate, lower-fat alternative to common liquid dietary supplements, and may serve to reverse the effects of many nutrient-depleting prescription and non-prescription drugs. With significant botanical and medical published research in both the academic and scientific literature, and with substantial ongoing research from the international community, the addition of *Moringa oleifera* into the daily diet shows considerable promise as an adjunct to improving health in a variety of important ways.

INTRODUCTION

Among the many new health supplements that appear on the market each year, one stands out as having several unique and significant nutritional qualities. Although new to the U.S., this product is common to a number of developing countries of the world. The product, *Moringa oleifera*, will be marketed in the U.S. under the name Zija. This product's tag line, drink life in™, may indeed be far more than a clever phrase, and initially appears to speak volumes about the remarkable character of the product itself.

This paper briefly reviews the research and several attributes of *Moringa oleifera* as a potent natural source of protein and suggests several ways in which this plant can serve both as an adjunct to low-calorie, high protein diets as well as an effective product to reverse the effects of nutrient-depleting prescription and non-prescription drugs common to many patients and consumers. This paper concludes with an analysis that evaluates the new product Zija with three other classes of comparable liquid nutritional supplements, and makes recommendations about how *Moringa oleifera* can provide a viable alternative to more balanced nutrition and ultimately to better health.

EMERGING RESEARCH

The validity and legitimacy of new health care products entering the marketplace must face the scrutiny of the scientific community. One measure of the potential success of a product includes the extent of research being conducted and reported in the current literature. While the benefits derived from *Moringa oleifera* have been used for centuries by developing nations and peoples, it is only recently that these benefits have been documented in both the botanical and medical literature. The National Library of Medicine (NLM), which contains over 15 million references for biomedical articles dating back to the 1950s, includes

an impressive collection of 82 citations for *Moringa* and 1,237 citations for cytokinin, a naturally occurring growth regulator and stimulator found in *Moringa oleifera* which is responsible for many of the properties of this remarkable plant.¹ These citations are represented in a wide variety of both academic and scientific journals from the international community.

Research studies evaluating the safety, efficacy and appropriateness of the benefits of cytokinins from *Moringa oleifera* include an expanding list of promising medicinal and nutritional uses. Although it may yet be too early to provide a significant number of documented claims about the specific benefits derived from *Moringa oleifera*, the breadth of current research appears to shed considerable light on many of the potential applications for products containing the primary ingredient of this plant. Thus far, some of these applications include: neurotransmission,² coagulation,³ anti-viral⁴ and antioxidant effects,⁵ use as an antifungal agent,⁶ hypoglycemic activity,⁷ radioprotective effects,⁸ regulation of thyroid hormone,⁹ and hypocholesterol activity.¹⁰ It is anticipated these potential benefits will ultimately translate into alternative modalities for treating a variety of medical conditions using a natural approach to patient care.

A LOW-CALORIE, SINGLE PROTEIN SOURCE

The leaf, seed and fruit powder of *Moringa oleifera* are naturally rich sources of vitamins and minerals. According to an analysis of 100 grams of the edible portion of *Moringa oleifera* pods, fresh (raw) leaves and dried leaf powder, the various parts of this plant have been shown to contain as much of the following water-soluble vitamins: 2.6mg of vitamin B1 (thiamine), 20.5mg of vitamin B2 (riboflavin), 8.2mg of vitamin B3 (nicotinic acid), and 220mg of vitamin C (ascorbic acid). In addition, this same portion of edible product contains as much of the following fat-soluble vitamins: 16.3mg of vitamin A, 113mg of vitamin E (alpha-tocopherol acetate);

as much as 423mg of the lipotropic element, Choline; 19.2 grams of fiber; and several key minerals: 2003mg of Calcium, 368mg of Magnesium, 204mg of Phosphorus, 1324mg of Potassium, 3.1mg of Copper, 28.2mg of Iron, and 870mg of Selenium.¹¹

In addition to these vitamins and minerals, one of the most significant benefits of *Moringa oleifera* is the ability of this plant to provide as much as 27.1 grams of protein (nearly 1/3 of the edible portion) including 19 of the 20 prominent protein amino acids (Table 1). The roles that amino acids play in the fundamental processes of tissue formation, regeneration and function are so distinctive that this class of substances is considered to be the primary component of all living matter. In contrast to fats and carbohydrates, which are also essential for life and which function primarily as energy sources, proteins vary widely in composition not only between living organisms but also among the various tissues and cellular fluids within a particular living organism.

TABLE 1
Prominent Protein Amino Acids Contained in *Moringa oleifera*

Chemical Property	Amino Acid	Essential	<i>Moringa oleifera</i>
Neutral Aliphatic	Glycine		√
	Alanine		√
	Serine		√
	Threonine	√	√
	Valine	√	√
	Leucine	√	√
	Isoleucine	√	√
Neutral Thioaliphatic	Cysteine		√
	Cystine		√
	Methionine	√	√
Neutral Aromatic	Phenylalanine	√	√
	Tyrosine		√
Neutral Heterocyclic	Proline		√
	Hydroxyproline		
	Tryptophan	√	√
Acidic	Aspartic Acid		√
	Glutamic Acid		√
Basic	Histidine		√
	Lysine	√	√
	Arginine		√

NOTE: In addition to the 20 standard amino acids listed above, several others of relatively rare occurrence have been isolated from hydrolysates of some specialized types of proteins. However, all are derivatives of the existing group of standard amino acids.

In addition to their roles as building blocks of proteins, the amino acids are precursors of many other important biomolecules, including various hormones, vitamins, coenzymes, alkaloids and porphyrins. The aromatic amino acids are especially versatile

precursors. From the amino acids are made alkaloids, such as morphine, codeine and papaverine, and a number of hormones. Some of these hormones include the thyroid hormone, thyroxine; the plant hormone, indole acidic acid and the adrenal hormone, epinephrine.¹²

The nutritional value of proteins in our diet involves understanding something about both the quality and the quantity of proteins consumed. Humans do not have the ability to synthesize all of the amino acids required for normal, good health. Those that must be supplied in our diets are called essential amino acids. *Moringa oleifera* contains all of the eight amino acids considered essential (Table 1). Although proteins found in meat, eggs and milk are considered to have the best nutritional value, such foods are those which should be limited due to their negative effect on serum cholesterol. Moreover, persons who either cannot or who choose not to consume these foods (persons who are lactose intolerant or those who are vegetarians) may run the risk of developing a protein deficiency.

Adequate protein nutrition obviously requires the consumption of sufficient protein to meet daily requirements. The protein must include the essential amino acids. Therefore, protein deficiency may be caused by either a reduced intake, or the use of low-quality protein. Symptoms of deficiency can include weight loss, nutritional edema, skin changes and may be associated with conditions such as nephrosis and colitis. Deficiency may also result in a lowered immune system since adequate protein intake is necessary for the formation of antibodies. Daily stress and pregnancy may also cause a deficiency of amino acids, and greater consumption of protein is required for these conditions for optimal health. For such individuals, *Moringa oleifera* is an important source of these vital nutrients.

PREVENTING THE NUTRIENT-DEPLETING EFFECTS OF COMMON DRUG USE

In addition to the potential for protein deficiencies that may result from poor dietary practices, the medical literature includes many examples of clinically significant prescription and non-prescription (OTC) drug-nutrient interactions that could result in a variety of nutritional losses. Although many patients who regularly take medications may not realize it, the importance of safeguarding nutrient levels while taking these drugs is critical. According to Ables and Batz,¹³ a partial list of several of the most notable drugs that can deplete nutrients is included in Table 2.

From this table, the extent of nutritional losses from drugs include the water-soluble and fat-soluble vitamins, folic acid, minerals and some drugs may even cause a reduction in the intestinal flora of the gastrointestinal tract which is critical for normal digestion and bowel functioning.

The list of medications in Table 2 includes ingredients of OTC antacids, anti-gas and laxative preparations. In addition, the list of prescription medications includes a variety of drugs used to treat acid reflux or GERD (Gastroesophageal Reflux Disease), infections, high cholesterol, seizures, water retention, and other conditions.

Because these classes of drugs represent such a broad base of common uses among many types of patients, the importance

of proper nutrition cannot be overstated. Whether or not an individual is taking these medications acutely or chronically, with so much potential nutritional loss at risk, the benefits of *Moringa oleifera* can be a very important adjunct to better and more balanced health.

TABLE 2
Nutrient-Depleting Prescription and Non-Prescription Drugs

Drug Class	How Used	Potential Nutrient Depleted
Antibiotics	Infections	Intestinal Flora, B Vitamins, Vitamin K
Aluminum Salt	Antacid, Anti-Gas	Calcium, Phosphorus
Carbamazepine	Seizures	Folic Acid, Vitamin D, Calcium
Cholestyramine	Cholesterol	Vitamins, A, D, E, K, Folic Acid
Corticosteroids	Various	Calcium, Vitamin D (indirectly)
Isoniazid	Tuberculosis	Vitamin B6
Loop Diuretics	Water Retention	Calcium, Magnesium, Potassium, Sodium, Thiamine, Zinc
Metformin	Blood Glucose	Vitamin B12
Methotrexate	Arthritis	Folic Acid
Mineral Oil	Laxative	Vitamins A, D, E, K, Calcium
Proton Pump Inhibitors	Acid Reflux	Vitamin B12
Thiazides	Water Retention	Magnesium, Sodium, Potassium, Zinc

SOURCE: Ables, J. & Batz, F. Drug influences on nutrient levels and depletion. Pharmacists Letter. 2000 Jan (Detail Document 160112):1-10.

NATURAL ALTERNATIVE TO TRADITIONAL LIQUID SUPPLEMENTS

Based upon a summary of work by Levien,¹⁴ the current availability of liquid nutritional and high protein supplements are formulated according to diet specificity and include seven general categories. These formulas are outlined in Table 3. While many of these formulas contain balanced nutrition in terms of protein, carbohydrate and fat content, they are generally very high in calories. When used appropriately, these liquid diets can provide important nutrition to individuals needing them, particularly if additional caloric intake is required. However, for those who prefer the nutritive value of a liquid supplement without the high calories, *Moringa oleifera* offers a unique alternative natural blend of nutrients with a very low caloric profile (fewer than 29 calories per serving). A comparison of the nutritional characteristics of Zija, the first available commercially-promoted *Moringa oleifera*-containing product in the United States, with three related categories is included in Table 4. These three categories were selected based upon their comparative mode of oral administration.

When Zija is compared to each of the three other nutritional formula categories, several findings emerge. Using the most conservative position, based upon a comparison of Zija with the lowest end of the range of carbohydrate content, fat content and overall calorie content represented by Milk-Based, Lactose-Free (without fiber) and Lactose-Free (with fiber) liquid nutritional formulas, Zija has a significantly lower carbohydrate, fat and calorie profile.

TABLE 3
A Description of Currently-Available Liquid Nutritional Supplements by Category

Milk-Based Defined Formula Diets	These products contain a lactose polymeric formula, are palatable, and are generally designed for oral use.
Lactose-Free Defined Formula Diets Without Fiber	These formulas are designed to meet the needs of most patients. Some of these products are palatable and can be administered orally while others are designed for feeding tube administration only. Some are best when used as supplements while others may be used to provide complete nutritional needs.
Lactose-Free Polymeric Formulas With Fiber	These products are the same as those described above, but contain added fiber. Although some are palatable and may be provided as oral supplements, others are designed for feeding tube administration.
Specialized Defined Formula Diets	These products are formulated to meet the nutritional requirements of patients with specific prescriptive-dietary needs. Some are appropriate for oral administration, others are designed for feeding tube administration only.
Monomeric or Elemental Formulations	These formulations are hydrolyzed to improve digestibility. They are poorly palatable and therefore are generally indicated for tube feeding only.
Blended Foodstuffs or Blenderized Formulas	Formulas in this category are generally used by patients with normal digestion and absorption ability. These products are not intended to be taken orally. The nutrients are derived from food sources to approximate a normal diet.
Modular Formulas	These formulas do not provide a complete diet. These products are available in forms containing protein-only, carbohydrate or fat components, or a combination of protein and fat.

SOURCE: Levien, T. Nutritional formulas. Pharmacists Letter. 1998 Apr (Detail Document 140413): 1-8.

Specifically on an equivalent-volume basis, Zija has 47.8 gram/L fewer carbohydrates, 5.6 gram/L fewer fats and 0.40 fewer Cal/mL than the leanest of the Milk-Based formulas. When compared to the leanest Lactose-Free(without fiber) formulas, Zija provides 29.5 gram/L fewer carbohydrates, 1.6 gram/L fewer fats and 0.32 fewer Cal/mL. Additionally, Zija contains 74.5 gram/L fewer carbohydrates, 22.8 gram/L fewer fats and 0.82 fewer Cal/mL than the leanest of the Lactose-Free (with fiber) nutritional formulas.

Furthermore, when the carbohydrate, fat and calorie values for Zija are expressed as a percentage of the lowest (leanest) of the group values of the three comparative formulas, Zija is effectively providing (at a minimum) an average of 56.8% fewer carbohydrates, 100% fewer fats, and 73.9% fewer calories. From this analysis of the calorie profile, Zija clearly offers an alternative to liquid nutritional supplement formulas with significantly fewer calories. This is important to consumers who prefer a lower calorie option while retaining the benefits of quality protein nutrition.

ENDORSEMENTS FROM THE FEDERAL GOVERNMENT

Over the last 15 years there has been a tremendous growth in herbal and nutritional supplement use by U.S. consumers. Between 1990 and 1997 alone, the use of herbals and high-dose vitamin supplements increased an impressive 380% and 130%,

respectively.¹⁵ Although not regulated in the same manner as prescription and OTC medications, the Food & Drug Administration (FDA) does regulate supplements under the Dietary Supplements Health and Education Act of 1994 (DSHEA), defining dietary supplements as products containing vitamins, minerals, herbs or other botanicals, amino acids, and substances such as enzymes, organ tissues, glandulars, and metabolites.¹⁵ Although the FDA does not require approval of dietary supplements before they are marketed, supplements containing a new dietary ingredient (not sold in the U.S. dietary supplement before October 15, 1994) must have a pre-market review for the purposes of ensuring product safety.¹⁵ In addition, the FDA also regulates the label content of dietary supplements and the health claims related to product manufacturing and packaging.

Nutritional Formula Category	Carbohydrate Content Range Gram/L (%)	Fat Content Range Gram/L (%)	Calorie Range Cal/mL
<i>Zija (Moringa oleifera)</i>	36.36	0.00	0.13
Milk-Based	86.3 - 416.0 (-57.9%) (-91.3%)	5.6 - 38.4 (-100%) (-100%)	0.58 - 1.09 (-77.6%) (-88.1%)
Lactose-Free (without Fiber)	68.0 - 217.3 (-46.5%) (-83.3%)	1.6 - 106.0 (-100%) (-100%)	0.5 - 2.0 (-74.0%) (-93.5%)
Lactose-Free (with Fiber)	113.0 - 215.8 (-67.8%) (-83.2%)	22.8 - 49.7 (-100%) (-100%)	1/0 - 1.28 (-87.0%) (-89.8%)
Average of Milk-Based and both Lactose-Free Formulas	89.1 - 283.0 (-59.2%) (-87.2%)	8.1 - 64.7 (-100%) (-100%)	0.69 - 1.46 (-81.1%) (-91.1%)

NOTE: Numbers in parentheses indicate the percentages by which Zija (Moringa oleifera) differs from the carbohydrate, fat and calorie values of the three nutritional formula categories.

SOURCE: Levien, T. Nutritional formulas. Pharmacists Letter. 1998 Apr Detail Document 140413):1-8.

With the introduction of Zija, developers have been working closely with several agencies of the federal government to obtain endorsements to support the validity, integrity and safety of this new product. Zija is currently obtaining Generally Recognized As Safe (GRAS) approval status from the United States Department of Agriculture. In addition, and in compliance with the requirements of the FDA (because this product is being used for the first time as a supplement in the United States), the formula for Zija is currently receiving a pre-market review by the FDA.

CONCLUSION

Considering the extent of current research and the nutritional value of Moringa oleifera from a single source, the benefits

of this product appear to be quite promising. Moreover, the reality of the nutrient-depleting capacity of a variety of commonly used prescription and non-prescription drugs supports the use of Moringa oleifera as a viable supplement for replenishing lost nutrients while optimizing overall health for individuals who are taking these medications. When compared to other available liquid nutritional supplement formulas, Moringa oleifera provides a variety of vitamins, minerals and protein amino acids with significantly less fat, less carbohydrate and fewer calories. The rich and complete source of protein amino acids available from Moringa oleifera makes this product an appropriate natural alternative for low-calorie diets requiring a full complement of protein amino acids. In addition to the complement of natural benefits derived from Moringa oleifera, the endorsement of Zija by governmental agencies further validates the safety and importance of this new product.

With the advent of Zija, the first available commercially-promoted Moringa oleifera-containing product sold in the U.S., the benefits of this product appear to be very promising. The potential for balanced nutrition and better health will be well served by this product's timely introduction, by its initial use in the U.S. and ultimately by its long-term use by anyone requiring a quality protein, low calorie natural supplement. Such a product will be a welcome addition to those desiring to optimize the benefits of long-term health with responsible nutritional practices.

Received October 2004

ABOUT THE AUTHOR

Brett C. Johnson has been a registered pharmacist for over 20 years and is currently in community practice. He received a clinical pharmacy degree from the University of Utah, an MBA degree from Brigham Young University, and is currently completing doctoral studies in Business Administration with a Pharmacy emphasis at California Coast University. Mr. Johnson has worked in hospitals, integrated delivery systems and managed care firms as a strategy and business development director, and as a market research and outcomes executive for a Fortune 300 firm. Mr. Johnson serves on the Advisory Board of the American Pharmacists Association (APhA) and is a mentor faculty member of BYU's Marriott School of Management. He is the author of numerous journal articles. Please send all comments and inquiries to Brett C. Johnson at bcjbj@msn.com.

REFERENCES

1. National Library of Medicine (PubMed). National Institutes of Health. Available from <http://www.ncbi.nlm.nih.gov/entrez/query.fcgi> 4 2004 Oct.
2. Ray, K., Hazrai, R. & Guha, D. Central inhibitory effect of Moringa oleifera root extract: possible role of neurotransmitters. Indian J Exp Biol. 2003 Nov;41 (11):1279-84.

3. Mandloi, M., Chaudhari, S. & Folkard, G. Evaluation of natural coagulants for direct filtration. *Environ Technol.* (2004) Apr; 25 (4):481-9.
4. Lipipun, V., Kurokawa, M., Suttisri, R., Taweechotipatr, P., Pramyothin, P., Hattori, M. & Shiraki, K. Efficacy of Thai medicinal plant extracts against herpes simplex virus type 1 infection in vitro and in vivo. *Antivir Res.* 2003 Nov; 60 (3):175-80.
5. Ashok, K. & Pari, L. Antioxidant action of *Moringa oleifera* Lam. (drumstick) against antitubercular drugs induced lipid peroxidation in rats. *J Med Food.* 2003 Fall; 6 (3):255-9.
6. Donli, P. & Dauda, H. Evaluation of aqueous *Moringa* seed extract as a seed treatment biofungicide for groundnuts. *Pest Manag Sci.* 2003 Sep; 59 (9):1060-2.
7. Kar, A., Choundhary, B. & Bandyopadhyay, N. Comparative evaluation of hypoglycaemic activity of some Indian medicinal plants in alloxan diabetic rats. *J Ethnopharmacol.* 2003 Jan; 84 (1):105-8.
8. Rao, A., Devi, P. & Kamath, R. In vivo radioprotective effect of *Moringa oleifera* leaves. *Indian J Exp Biol.* 2001 Sep; 39 (9):858-63.
9. Tahiliani, P. & Kar, A. Role of *Moringa oleifera* leaf extract in the regulation of thyroid hormone status in adult male and female rats. *Pharmacol Res.* 2000 Mar; 41 (3):319-23.
10. Ghasi, S., Nwobodo, E. & Ofili, J. Hypocholesterolemic effects of crude extract of leaf of *Moringa oleifera* Lam. in high-fat diet fed wistar rats. *J Ethnopharmacol.* 2000 Jan; 69 (1):21-5.
11. Hirsch, A. Preliminary document on the nutritional value of leaves and pods of *Moringa oleifera*. UCLA, Department of Botany, 2004.
12. Gennaro, Alfonso & Van Meter, Clarence. "Natural Products" in Hoover, John (Ed.). *Remington's Pharmaceutical Sciences*, 15th ed. Easton, PA Mack Publishing Company, 1975. 416-445.
13. Ables, J. & Batz, F. Drug influences on nutrient levels and depletion. *Pharmacists Letter.* 2000 Jan (Detail Document No. 160112):1-10.
14. Levien, T. Nutritional formulas. *Pharmacists Letter.* 1998 Apr (Detail Document No. 140413):1-8.
15. Palacioz, K. Dietary supplement seals of approval. *Pharmacists Letter.* 2003 Jan (Detail Document No. 190112):1-3.

Address reprint requests to:

KOS Health Publications
466 Foothill Blvd. #251
La Cañada, California 91011

Email: info@koshealthpub.com