Nutritional Quality of Organically Grown Food

by Steve Diver
Appropriate Technology Transfer for Rural Areas -- ATTRA
Fayetteville, Arkansas

Farmers often ask ATTRA for data on the nutritional quality of organic food (grains, fruits, vegetables) in comparison to conventionally raised food. This publication summarizes some of the facts and viewpoints surrounding this issue, and provides resources for further reading.

"Healthy soils equals healthy food equals healthy people" is a fundamental tenet of many ecological farming systems. Yet, the nutritional quality of food grown by organic and conventional methods is the subject of much controversy.

Organic advocates claim organically grown foods are nutritionally superior because such foods contain higher levels of vitamins, minerals, and amino acids. On the other hand, the mainstream scientific community disputes these claims, arguing instead that nutritional differences do not exist. "Plants can't tell the difference between organic and chemical fertilizers" is an oft quoted statement in support of this latter viewpoint.

An examination of the literature revealed that quite a few studies have been published on this topic. A selection of references is listed in the further reading sections below. In short, the data on nutritional quality of organic produce in comparison to conventional produce are inconclusive. Some research reports point to statistical differences, while other studies do not.

Dr. Joan Gussow, Professor Emeritus of Nutrition and Education at Columbia Teachers College, conducted an extensive review of this topic. In an assessment of the varied scientific research conducted to date, she concludes:

> Lacking such careful studies, there is enough cumulative evidence to indicate—to those who wish to be convinced —that organic foods have a variety of qualities that should over the long term make them more healthful— including lower levels of pesticide residue, lower levels of nitrate-nitrogen, greater density, better flavor if they are properly handled, etc. But the available studies are conflicting enough to convince anyone who isn't a fan of organic, that any differences that can be demonstrated are not worth writing home about, and are certainly not a reason to promote organic food (1).

At the end of her article "Is Organic Food More Nutritious?" she prods the organic industry to move beyond harping on a few nutritional differences when organic production provides so many other benefits worth promoting: conserves natural resources, solves rather than creates environmental problems, and reduces the pollution of air, water, soil, and food.

A panel of food safety and nutrition experts associated with the Institute of Food Technologists came to the following conclusion in a study titled "Organically Grown Foods:"

> A justification for the purchase of organically grown food cannot be made on the basis of any superiority in nutrition, taste, or freedom from pesticides. Advantages have been identified, however, with the practice of organic farming. Advantages cited include agronomic and environmental benefits. The future of the organically grown foods market more appropriately depends on the viability of the organic farming system as an alternative agricultural practice which offers effective solutions to the detrimental effects on the environment and nonsustaining aspects of conventional farming practices (2).

Greg and Pat Williams, editors of the HortIdeas newsletter, came to the following conclusion back in 1987, when they reviewed yet another inconclusive research study. They wrote:

> Again, these results are in accord with other "organic vs. conventional" vegetable trials that we have seen, and that have prompted us to argue for an "organic" approach to gardening on the basis of environmental considerations rather than some dubious "miraculous" nutritional properties of the "organic" produce. [But we're always open to new information on the fertilizer/nutrition connection.] (3).

Ten years later, in 1997, they reviewed 12 more research papers on this topic in an article titled "Organic vs. Conventional Growing Methods, Revisited" (4). Most of the studies were "about the same" with respect to nutritional factors and yield.

In *Components*, the technical newsletter from UC Sustainable Agriculture Research and Education Program (UC-SAREP) at the University of California, Gail Feenstra reviewed a European study on vitamin and mineral content of carrot and celeriac grown under mineral or organic fertilization. Though the researchers reported significant nutritional differences between organic and commercial fertilizer treatments, Feenstra raised a number of questions regarding experimental protocol. One of her questions deals with the concept of early-stage organic transition versus long-term organic conversion, "This time factor could affect the soil quality and potentially, the nutritional quality of the vegetables." Further, she concludes:

> Finally, despite the interest this type of study attracts, it is important to bear in mind that the differences between organic and conventional produce must be considered within a broad context. Although consistent differences in specific nutrients may eventually be found, their contribution to overall health is questionable, given North Americans' and Europeans' access to food. Choosing organically grown produce for its contribution to the long-

term health of the soil and our capacity to produce food sustainably may ultimately be more important than its contribution to individual nutritional health (5).

David Leonard, an agro-nutritionist from Arizona, says that eating habits play a larger role in health than the organic vs. conventional food production paradigm. His views—excerpts from a post on the Sustainable Agriculture Network's Internet discussion group— are summarized below (6):

> I think that organic agriculture may miss an ideal opportunity to maximize its potential impact on American's health and sustainable wellness unless it broadens its mission beyond environmental friendliness and the production of nutritious food (whether or not that food is actually nutritionally superior). The agriculture-nutrition-wellness connection involves more than farming, especially these days when nutritious food leaving the farm gate is less likely than ever to translate into healthy eating. Some reasons:
>
> 1. Modern food processing adds fat (usually unhealthy hydrogenated oils), sugar, and salt to many products and often markedly reduces the fiber content and vitamin/mineral content of cereal grains.
>
> 2. It's harder than ever to know how to select healthy foods, given the mind-boggling array of supermarket food choices and the proliferation of low-fat, fake-fat, artificially sweetened, or vitamin-fortified "techno-foods."
>
> 3. The public is understandably confused about nutrition. Just look at any bookstore's collection of diet books to get a consensus opinion on how to eat well.
>
> 4. We've become a food-obsessed society and now eat over 200 calories a day more than in 1978. About 45% of the typical U.S. family's food budget is now spent at restaurants (usually fast food) vs. 25% in 1950.
>
> 5. America's major nutritional legacy (and, indeed our federal dietary guidelines until the 1992 introduction of the USDA Food Guide Pyramid) stems from traditional Anglo-Germanic eating patterns favoring a high-fat, low-fiber diet where meat and dairy products play a central role. Numerous diet/disease studies worldwide have correlated this eating style with a much higher rate of chronic degenerative diseases (heart disease, cancer, osteoporosis, diabetes, etc.) than in the case of plant-centered diets.

One study that's often mentioned in the organic vs. conventional debate is the Firman E. Bear report. This report **DID NOT** look at the nutritional differences between organic and conventionally raised produce, though the popular press has incorrectly portrayed it in this manner for many years. The study, published in a 1948 edition of *Proceedings of the Soil Science Society of America* (7), examined the mineral composition of vegetables grown in different regions and on different soil types. Part of the more recent confusion may stem from the way the results were presented; i.e., organic and inorganic **soil types** rather than organic and conventional **production methods**.

Dr. Bear and his colleagues found that vegetables grown on heavy soils in the Ohio Valley had a greater mineral content than produce grown on sandy Coastal Plain soils near the East Coast. Interestingly, fertilizer rates on farms in the coastal-plain states were much higher in contrast to fertilizer rates used on farms in east north-central states. Clover sods and manures were more prevalent in the east north-central region. These results are important in themselves because they show that **soil type** (and quite likely differences in clay mineralogy, soil organic matter, and biological soil activity) affect the mineral composition of foods grown on them. In general, they found that trace element and mineral content increases from south to north, and from east to west. Overall, mineral composition is affected by geography, climate, and fertilizing practices.

A full-text version of the infamous "Firman Bear Report" can be found online at the Rutgers University website:

> **Variation in Mineral Composition of Vegetables**
> Firman E. Bear, Stephen J. Toth, and Arthur L. Prince
> http://www.rce.rutgers.edu/pubs/bearreport/
>
> Reprinted from Soil Science Society of America Proceedings 1948,
> Volume 13. pp. 380-4, The Soil Science Society of America,
> Madison, Wisconsin, 1949.

There are many environmental and cultural factors that influence the nutritional composition of produce, and these may ultimately play a greater role in food quality than simple organic versus conventional logic.

Environmental conditions likely to affect food quality include geographical area, soil type, soil moisture, soil health (humus content, fertility, microbial activity, etc.), weather and climatic conditions (temperature, rainfall, flooding, drought), and pollution.

Cultural practices likely to affect food quality include humus management techniques such as green manuring and composting, variety, seed source, length of growing season, irrigation, fertilization, cultivation, and postharvest handling (especially temperature and relative humidity).

For a comprehensive review of the topic, see Sharon Hornick's article "Factors Affecting the Nutritional Quality of Crops." Her paper was published in a special issue of *The American Journal of Alternative Agriculture* containing the Proceedings of a Conference on the Assessment and Monitoring of Soil Quality (8).

Having summarized some of the viewpoints underlying the debate as well as identifying the many factors affecting food quality, let us now turn our attention to some of the noteworthy ideas, practices, and publications from the sustainable farming and holistic health movements that address the link between farming method, soil quality, and food quality in general.

A common thread in alternative agriculture and health literature is declining food quality in the industrialized food production system. As early as the 1930s, writers saw a link between nutrient-depleted soils and increased health problems (9-10).

> The alarming fact is that foods -- fruits and vegetables and grains -- now being raised on million acres of land that no longer contains enough of certain needed minerals, are starving us, no matter how much of them we eat.
> -- U.S. Senate Document 264, 1936

The *Acres,U.S.A* articles “Exhausted Soil Produces Exhausted People,” by Sam Hood (June 1993, p. 30 & 39) and “The Argument for 'Expensive Urine'“ by Joel Wallach (November 1993, p. 24) provide examples from the alternative press that depleted soils result in increased health problems (11). In addition, Hood suggests that soil fungi play a vital role in plant nutrition, that the fungi actively stimulate synthesis of amino acids, proteins, and other plant nutritive factors in addition to their well-known symbiotic benefits such as assimilation of water and nutrients, especially phosphorus.

While it is common knowledge that soil microorganisms influence plant nutrition by virtue of their role in decomposition and mineralization of organic matter, the view that microorganisms stimulate plant metabolism and enhance plant nutrition is certainly more holistic in nature than the quantitative-mechanical view that soil microbes merely breakdown organic matter and release mineral ions into the soil solution. In this, there is an interesting correlation to research associated with bioponics.

> Bioponics is a new kind of hydroponic plant production system. The term bioponics means "life working," which differs from hydroponics which means "water working." Dr. Luther Thomas has published a series of articles on the emerging technology of bioponics in *The Growing Edge* magazine.
>
> Thomas is a marine biologist who discovered bioponics while working with sea plants. He found that a number of sea plants would not grow in artificial sea water. They only grew when he inoculated the solution with a few drops of sea water. Thomas figured out that the missing ingredient was not a nutrient or trace element; it was the living element, or the microorganisms present in the ocean, that enabled the plants to grow normally.
>
> In bioponics, marine algae adapted to fresh water conditions are introduced into a hydroponic medium. The microbes help stabilize pH and fix nitrogen. These microbes also produce enzymes which stimulate plant biochemical processes. Plant traits subsequently affected include such things as **flavor** and **appearance** of vegetables. Metabolites produced by the microbes -- such as gibberellins, auxins, and vitamins -- enhance plant growth.
>
> From: *Hydroponic Vegetable Production*
> Appropriate Technology Transfer for Rural Areas, 1995

A few of the alternative health books that address demineralization of soils and declining health include *Rare Earths: Forbidden Cures* (17) by Dr. Joel Wallach and *Empty Harvest* (18) by Dr. Bernard Jensen. An audio tape by Wallach, *Dead Doctors Don’t Lie*, discusses the importance of minerals, vitamins, and other nutrients in reversing disease and ensuring good health and longevity, accompanied with the promotion of “colloidal minerals” as dietary supplements (19).

> …all animals get their food directly or indirectly from plants, and all plants get their food from the soil. Therefore, mineral-deficient soil may be one of the greatest original sources of disease in the world today. According to D. W. Cavanaugh, M.D., of Cornell University, "There is only one major disease and that is malnutrition. All ailments and afflictions to which we may fall heir are directly traceable to this major disease." Simply stated, food crops grown on depleted soil produce malnourished bodies, and disease preys on malnourished bodies.
> – *Empty Harvest*, 1990.

The Healing Power of Minerals, Special Nutrients and Trace Elements (20) by Paul Bergner includes USDA figures that show a decline in mineral and vitamin content of several fruits and vegetables between 1914, 1963, and 1992. Table 1 is a summary of mineral decreases in fruits and vegetables over a 30-year period, adapted from Bergner’s book.

Table 1. Average changes in the mineral content of some fruits and vegetables†, 1963-1992

Mineral	Average % Change
Calcium	-29.82
Iron	-32.00
Magnesium	-21.08
Phosphorus	-11.09
Potassium	-6.48

† Fruits and vegetables measured: oranges, apples, bananas, carrots, potatoes, corn, tomatoes, celery, romaine lettuce, broccoli, iceberg lettuce, collard greens, and chard

Paul Bergner's *The Healing Power of Minerals, Special Nutrients and Trace Elements* from Prima Publishing is one of the better popular press health books on the importance and function of minerals in food. Bergner is the clinic director of the Rocky Mountain Center for Botanical Studies, and editor of *Clinical Nutrition Update* and *Medical Herbalism* newsletters. The list price is $15 through:

Prima Publishing
P.O. Box 1260BK
Rocklin, CA 95677
916-632-4400
http://www.primapublishing.com/

In England, Anne Marie-Mayer compared food composition over a 50-year period using data from the UK Ministry of Agriculture, Fisheries and Food (MAFF). Her study (21), "Historical Changes in the Mineral Content of Fruits and Vegetables" was presented at the Agricultural Production and Nutrition conference held at Tufts University School of Nutrition Science and Policy on March 19-21, 1997. Table 2, adapted from Marie-Mayer's paper, summarizes the average ratio of nutrient content and dry matter of 20 vegetables and 20 fruits. A ratio of 0.81 for Ca, for example, means that over an approximately 50-year period the average content of calcium in vegetables has declined to 81% of the original level.

Table 2. Average ratio of mineral content and dry matter (new/old) for vegetables and 20 fruits†

	Ca	Mg	Fe	Cu	Na	K	P	D.M.
Vegetable ratio	0.81†	0.65†	0.78	0.19†	0.57†	0.86	0.94	
Fruit ratio	1.00	0.89†	0.68†	0.64†	0.90	0.80†	0.99	

† The symbol † indicates a statistical difference

Two agriculture books that provide an introduction to the concept of nutrient-depleted foods, as well as fertility programs to remineralize soils, are reviewed below.

Nourishment Home Grown (22) by Dr. A.F. Beddoe follows the notion that a decline in American health is due to demineralized soil conditions. Beddoe promotes fertilizer practices based on the theories of the late Dr. Carey Reams to raise foods with a higher nutrient density. One of Carey Reams contributions to alternative agriculture was the Biological Theory of Ionization, which says that "All disease is the result of a mineral deficiency or loss of mineral energy, whether plant, animal, or human." Beddoe's book is available through Pike Lab Supplies in Strong, Maine for about $20.00. Contact:

Pike Lab Supplies
RR 2, Box 710
Strong, ME 04983
207-684-5131
207-684-5133 Fax
Contact: Bob Pike
info@pikeagri.com
http://www.pikeagri.com/

Super Nutrition Gardening (23) by Dr. William S. Peavy and Warren Peary lists numerous references to scientific and USDA literature that support the relation of food nutrition to the condition of soils. Following sections on food nutrition, the remainder of the book focuses on organic gardening techniques. In particular, the authors outline of a seven-step program for restoring soil fertility. Peavy and Peary's book is available for about $14.95 through:

Avery Publishing Group
120 Old Broadway
Garden City Park, NY 11040

Remineralize the Earth—RE, Inc.— is a non-profit organization that promotes the regeneration of soils and forests with finely ground gravel dust as an economically and ecologically sustainable alternative to chemical fertilizers and pesticides. In the 1980s and 90s, RE, Inc. published a quarterly journal, *Remineralize the Earth*. Back issues are an excellent way to learn about farming practices associated with rock dusts, scientific research, and resource listings of supplies and publications. Though it discontinued its print journal, RE, Inc maintains a website with articles from past journal issues, research reports, and an electronic forum on soil remineralization. RE, Inc. plans to develop an online magazine, a monthly digital newsletter, and a research database.

Joanne Campe, the editor, has compiled extensive resource packets containing research and practitioner-based information on the use of rock dusts in agriculture and forestry. Packets include:

- Soil Remineralization: Agriculture, 146 pages. $17.00

- Soil Remineralization: Forestry and Sewage Treatment, 82 pages. $12.00
- Complete Set for both Agriculture & Forestry/Sewage Sludge. $25.00

For further information, contact:

> Remineralize the Earth
> 152 South Street
> Northampton, MA 01060-4021
> 413-586-4429
> Contact: Joanne Campe
> Email: ReminEarth@aol.com
> http://www.remineralize-the-earth.org/

In addition to standard methods of analysis—such as comparative taste tests or quantitative analysis of mineral content—some researchers have examined food quality by observing the effects of feeding biologically- versus conventionally-grown feeds on animals (24-26).

The refractometer, a precision optical instrument commonly used in the produce industry, is gaining wider usage among organic farmers and crop advisors. It measures soluble solids and sugars in sap squeezed from fruits or vegetables, and reports the results on a scale known as Brix°. A higher Brix reading usually correlates to better taste, and in some instances, higher mineral content. Alternative farmers and crop advisors are monitoring crops with refractometers to understand how soil amendments and practices such as humates, rock dusts, and foliar feeding affect Brix readings.

Darkfield microscopy, a specialized illumination technique used in light microscopy, is gaining increased usage by holistic health practitioners in the study of nutritional supplements and dietary changes and how they affect live blood samples from patients. By studying changes in cellular structure and blood flora, technicians can discern patterns which are associated with healthy blood and those recognized as indicators of disease or poor nutrition.

When asked if darkfield microscopy can be used to detect links between soil health and food quality, one laboratory worker (26) said, “For a clear division between organic and commercially grown fruits and vegetable this technique [darkfield microscopy] is very, very revealing.” Further information— articles, photos, training materials— on the darkfield technqiue can be found at the Nu-Life Sciences (see Dr. Michael Coyle) web site in California (27) and at the Center for Somatidian Orthobiogy (see Dr. Gaston Naessens) web site in Quebec, Canada (28).

An alternative approach to measuring food quality is the use of novel methods of qualitative analysis. These methods are reviewed by Lampkin in *Organic Farming* (29). These include (a) image-forming techniques such as certain types of copper-chloride crystallization and chromatography, (b) physical-chemical techniques such as counting photon emissions from samples of food and measuring electrical conductivity and other electro-chemical properties of food, and (c) microbiological and biochemical techniques.

Regarding the photon emission method, Lampkin writes:

> Of particular interest is the technique of counting photon emissions. Every living organism emits biophotons or low-level luminescence (light with a wavelength between 200 and 800 nanometers). This light energy is thought to be stored in the DNA during photosynthesis and is transmitted continuously by the cell. It is thought that the higher the level of light energy a cell emits, the greater its vitality and the potential for the transfer of that energy to the individual which consumes it. Significant differences have been found in favour of organically produced food (Figures 15.6 and 15.7), but differences also occur with respect to location, freshness and stage of maturity (ripeness) (p. 571-572).

Of these methods, the copper crystallization and paper chromatography techniques seem to be gaining wider recognition. For example, see Knorr and Vogtmann’s article titled “Quality and Quality Determination of Ecologically Grown Foods” in *Sustainable Food Systems* (30), or consult Dietrich Knorr’s paper on chromatography in *Biological Agriculture and Horticulture* (31).

According to literature from the Elm Farm Research Centre in England (32), "the employment of these novel methods is an attempt to identify a characteristic of food other than the currently measurable components such as nutrients, vitamins, and residues. This characteristic, which could be called ‘vitality’, is thought by some to be important to the health of all living organisms and can be passed on through the food chain."

The concept of “vital energy” doesn’t have much history in Western science. In the Orient, however, where it is known variously as “prana” or “chi”, bioenergetic healing systems are centuries old. The concept is integral to naturopathic health traditions such as ayurveda, yoga, tantra, acupuncture, QiGong, and tai chi.

Likewise, bioenergy is an important feature of several alternative farming systems. Three examples follow:

Farmers and crop advisors who follow the fertility management guidelines established by Dr. Carey Reams use electronic scanners, or radionic instruments, to measure the "general vitality" of soil, plant, and animal samples. In turn, radionic instruments are used to formulate feed and fertilizer programs with the intention of enhancing the vitality readings and health

of farm animals or crops. For more information on Reams or radionics, request the ATTRA publications titled *Albrecht/Reams Biological Fertility Systems* and *Radionics in Agriculture*.

The second alternative farming system, biodynamic agriculture, is unique in that it purports to increase cosmic and terrestrial forces in nature through the use of biodynamic preparations and herbal sprays which, in turn, enrich the farm, its products, and its inhabitants with life energy. Products marketed under Demeter® label — the certified biodynamic label first used in 1928 — are promoted as an enlivened, high quality food source within this context.

Founded by the Austrian philosopher Rudolf Steiner in the 1920s, biodynamic farming was formed under the premise that a decline in feed and food quality on German farms paralleled the introduction of commercial fertilizers. Humus management practices such as forage-based crop rotations, integration of crops and livestock, green manuring, composting, cover cropping, and microbial inoculation play an especially important role on biodynamic farms.

For an overview on this topic, see ATTRA's:

Biodynamic Farming & Compost Preparation
http://www.attra.org/attra-pub/biodynamic.html

A unique contribution of the biodynamic movement has been the development and popularization of two qualitative tests: paper chromatography and sensitive crystallization.

Chromatography Applied to Quality Testing is 44-page booklet by Dr. Ehrenfried Pfeiffer on the paper chromatography method. Pfeiffer made extensive use of the chroma test in his research at the Pfeiffer Foundation in Spring Valley, New York. Included are laboratory standards for preparation and extractions of samples. The book contains color plates and descriptive entries for chroma tests performed on different samples of soil, compost, and grain. It lists for $8 through Biodynamic Farming & Gardening Association (BDFGA) in San Francisco, California .

Sensitive Crystallization: A Demonstration of Formative Forces in the Blood is a 59-page booklet by Dr. Ehrenfried Pfeiffer. Pfeiffer developed the sensitive crystallization technique in the early 1930s. In 1939 he was awarded an honorary M.D. from Hahnemann Medical College in Philadelphia in recognition of his research on the early diagnosis of cancer using this method. The sensitive crystallization technique can also be used in the analysis of plants, produce, grain, and fodder. It lists for $16 through BFDGA. Contact:

> Biodynamic Farming and Gardening Association, Inc
> Building 1002B, Thoreau Center, The Presidio
> P.O. Box 29135
> San Francisco, CA 94129-0135
> 415-561-7797
> 415-561-7796 Fax
> biodynamic@aol.com
> http://www.biodynamics.com/

The third alternative farming system with a special focus on food quality is Nature Farming. In both organizations that promote Nature Farming — Kyusei Nature Farming and MOA Nature Farming — the production of healthy nutritious foods is a central goal. Healthy foods grown on healthy soils are understood to play an underlying role in human health; and further, such foods contain an important life force separate from its mineral or chemical constituents. In the Kyusei Nature Farming branch, Effective Microorganisms® are used to inoculate composts, green manures, irrigation water, and other organic soil amendments to manipulate the microbial soil environment and enhance soil health and food quality.

For an overview on this topic, see:

Nature Farming and Effective Microorganisms
http://ncatark.uark.edu/~steved/Nature-Farm-EM.html

Food quality is defined more broadly by the Soil Association in England. It adopted standards developed at the University of Kassel and the Elm Farm Research Centre, two European research institutes actively conducting organic farming systems research. Six criteria — Sensual, Authenticity, Functional, Nutritional, Biological, and Ethical — make up this new holistic approach.

Six Aspects of Food Quality:

Sensual: how good it feels to eat. Taste, smell, texture, look, feel; that wonderful blend of sensations when you bite into a freshly picked apple.

Authenticity: the food which consumers expect. Food which has not been synthesized or adulterated in production, processing or storage. Bread where the browness is real, not an added ingredient to white bread.

Functional: how appropriate food is to its specific purpose. For example, the way different varieties of potatoes are more or less suitable for boiling, baking, roasting or frying.

Nutritional: how it contributes to a balanced diet. Recognizing individual food's value by the vitamins, protein or trace elements present.

Biological: how it interacts with the body's functioning. Allergic reactions to additives, the effects of agri-chemical residues; beneficial role of live yoghurt on the gut flora, etc.

Ethical: environmental, social and political values. How food production treats animals, the environment, and the people producing the food.

Resources:

Agricultural Production and Nutrition is the proceedings of an international conference organized by the Tufts University School of Nutrition Science and Policy, held March 1997. The 214-page book contains twenty-one papers. Enclosed for your information is an announcement regarding the proceedings, which contains a list of paper titles. It is available for $18 with pre-payment or $21 if billed (checks payable to "Trustees of Tufts College") from:

Agriculture and Nutrition Conference
School of Nutrition Science and Policy
Tufts University
Medford, MA 02155

Food Quality: Concepts & Methodology is the proceedings of an international colloquium organized by the Elm Farm Research Centre and the University of Kassel. It is a 64-page book published in 1992. It is available for 10 pounds in English currency (about $20.00). Contact:

Elm Farm Research Centre
Hamstead Marshall
Near Newbury
Berkshire RG20 OHR, Great Britain
Tel: 01488 658298
Fax: 01488 658503
education@efrc.com
http://www.efrc.com/

Especially See:

EFRC Education Pack: Food Quality
http://www.efrc.com/education/student2.htm

Resource packet with printed material containing EFRC information sheets and briefing notes.

"Raindrops on Roses and Whiskers on Kittens" -- Consumer's Perceptions on Organic Food Quality?
By Lawrence Woodward and Angelika Meier-Ploeger
Presented at the IFOAM Conference, Mar Del Plata, Argentina, November 1998
http://www.efrc.com/research/rorawok.doc

8-page article available as document download

The Ecological Agriculture Project at MacDonald College of McGill University in Canada has published several informative reports and bibliographies on this topic. Titles include:

- Soil Conditions and Food Quality
- Soil Fertility and the Nutritional Quality of Food
- Comparison of Food Quality of Organically Versus Conventionally Grown Plant Foods
- Agriculture, Ecology, and Overconsumption
- Soil, Food, Health and Values
- Nutritional Characteristics of Organic,Freshly Stone-Ground Sourdough & Conventional Breads

To order these reports, or to view them online, contact:

Ecological Agriculture Project
Box 191, MacDonald College
21,111 Lakeshore
Ste-Anne De Bellevue, Quebec
Canada H9X 1CO
http://www.eap.mcgill.ca/

Organically Produced Foods: Nutritive Content is a 21-page bibliography compiled by Mary Gold at the Alternative Farming

Systems Information Center, National Agricultural Library. It consists of about 216 literature citations that specifically focus on the nutritive value of organically produced foods, including vitamin and mineral content, as well as related chemical constituents. It is located on the web at:

Organically Produced Foods: Nutritive Content
Special Reference Briefs Series no. SRB 2000-03
Compiled by: Mary V. Gold
Alternative Farming Systems Information Center, National Agricultural Library
http://www.nal.usda.gov/afsic/AFSIC_pubs/srb0003.htm

BrixTalk@egroups.com is an electronic forum that focuses on food quality, using refractometers to ascertain Brix as an indicator of taste. Here it may be useful to restate that Brix is the scale that measures soluble solids and sugars in sap squeezed from fruits and vegetables. *BrixTalk* promotes the use of hand held refractometers by farmers and gardeners and consumers to ascertain on-the-spot Brix readings as an indicator of good tasting fruits and vegetables. An underlying assumption is that produce measuring high Brix will also have higher levels of minerals and amino acids. *BrixTalk* draws heavily on the fertility management philosophy of Dr. Carey Reams and modern day crop advisors like Dr. Dan Skow and Dr. Arden Anderson. Carey Reams advocated soil- and foliar-applied fertilization schemes to increase the energy in the soil, to increase pest resistance, and to increase soluble solids in foods that result in a high Brix reading. To subscribe, go to: <http://www.egroups.com/invite/BrixTalk>

Web Links at Worldsite Crossroads, Home of BrixTalk
http://www.crossroads.ws/

Using a Refractometer to Test the Quality of Fruits & Vegetables
By Rex Harrill
http://www.crossroads.ws/brixbook/BBook.htm

> *Using a Refractometer to Test the Quality of Fruits & Vegetables* is a 42-page online booklet by Rex Harrill that provides a historical glimpse into Dr. Carey Reams research on Brix=Quality, charts that are used as indicators of Poor, Average, Good, and Excellent quality, instrumentation, etc.

Brix=Quality: Don't Believe What You've Been Told About Food!
http://www.crossroads.ws/brix/index.htm

Senate Document 264
Text of Dr. Charles Northern's testimony on mineral depletion of foods
http://www.crossroads.ws/brix/index-page5.html

How to Grow Superb Biological Produce Above & Beyond Ordinary Chemical OR Organic Agriculture
http://www.crossroads.ws/CRActive/PikeAg.htm

Organic Produce in the Broader Context of Ecological Farming:

Here, it may be helpful to make a rather important distinction between ecological farming systems and organic agriculture in general, and certified organic production in particular.

Organic agriculture may be viewed in much the same way as sustainable agriculture; i.e., a large umbrella under which many different methods of production, products, and philosophies exist. The goal — permanent culture, deep organics, farming systems designed to take advantage of inherent ecosystem integrity, farms which exist on current and non-polluting resources, etc. — may be viewed as a continuum that encompasses a broad spectrum of agricultural concepts and practices that strive towards ecological health rather than one pre-determined production system set in stone for all time.

On the other hand, certified organic production is somewhat arbitrary. It is a market-based arrangement in which farmers certify to consumers that their farm products have followed an approved set of guidelines set forth by an organic certification agency. Such guidelines assume the production of pesticide-free or otherwise healthy products because they are based on a list of approved versus restricted fertilizers and pest control products.

However, the classification of these products — whether they are of "natural" or "synthetic" origin — is arbitrary. That is, a farmer may be certified if he or she meets the specified guidelines. The assumption is that an organic farm will by necessity follow good husbandry practices such as humus management and mineral supplementation that result in good quality foods, but that is not always or necessarily the situation, especially on early-transition organic farms.

In summary, it should be clear that certification of an organic farm alone will not result in an automatic difference in nutritional composition of foods. Rather, as Sharon Hornick's article pointed out, there are many factors that influence food quality.

Secondly, in a discussion of "organic versus conventional" production as it relates to food nutrition, one should not lose sight of the many farms and alternative farming systems that follow the principles of organic agriculture, but do not follow certified

organic production practices *per se*. Some of these farms — for example those following the Reams fertility management system — make selective use of commercial fertilizers with a goal of mineral-dense nutritious foods. There are many instances where these ecologically-oriented farms produce foods of superior nutritional quality than their certified organic counterparts.

Finally, there is good reason to understand how organic agricultural practices in general are right on track towards providing the necessary soil conditions that promote foods with good, and sometimes even superior, nutritional qualities. It should be clear from the novel qualitative tests and concepts outlined herein, that alternative agriculture has made significant contributions to non-traditional concepts and practices relating to soil health and food quality

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The Firman Bear "Report"

Variation in Mineral Composition of Vegetables
Firman E. Bear, Stephen J. Toth, and Arthur L. Prince
http://www.rce.rutgers.edu/pubs/bearreport/index.html

> The Rutgers University study reprinted from Soil Science Society of America Proceedings 1948, Volume 13. pp. 380-4, The Soil Science Society of America, Madison, Wisconsin, 1949.

Nutrition and Biodynamics

Nutrition and Biodynamics: Evidence for the Nutritional Superiority of Organic Crops
by Virginia Worthington MS, ScD, CNS.

[Originally published in Biodynamics, Vol. 224, July/August, 1999)
http://www.biodynamics.com/biodynamicsarticles/worth.html

Note: This is one of the better literature reviews on this subject in recent years. Worthington presents the data in an easy-to-understand way, accompanied with an extensive list of literature citations. She concludes:

"We have seen a pattern of better nutrient composition in organic crops, better health in animals consuming organic food and the existence of known mechanisms explaining observed differences between organic and conventional crops. Biodynamic crops performed extremely well on the most important measure, the health of consumers. Whatever problems there may be with the quantity or quality of existing studies, the body of evidence, at a minimum, provides strong indications that organic crops are more nutritious."

European Research

Long-Term Field Experiment in Sweden: Effects of Organic and Inorganic Fertilizers on Soil Fertility and Crop Quality
(In Proceedings of an International Conference in Boston, Tufts University,
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By Artur Granstedt & Lars Kjellenberg
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Influences of Bio-Dynamic and Organic Treatments on Yield and Quality of Wheat and Potatoes: The way to Applied Allelopathy
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http://www.wye.ac.uk/agriculture/sarg/oral96.html

Qualitative Assay Methods from Anthroposophy & Biodynamic Agriculture, The European Contribution

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Sensitive Crystallization Anaylsis (Now in English!!)
Hagalis Assoziation, Switzerland
http://www.hagalis.purespace.de/PuretecEnglisch/Kristeng/ppframe.htm
Sensitive Crystallisation Slide Show. HIGHLY RECOMMENDED !!!!!

The Renaissance of Farming: A Vision for Organic Farming in the 21st Century, Proceedings
Soil Association Conference, 7-9 January 2000
Royal Agricultural College, Cirencester (UK)

Measuring Food Quality
Peter Segger for Dr Ursula Balzer-Graf - Institute of Vital Quality, Switzerland
5-page paper, PDF download

APPENDIX III: Dr Ursula Balzer-Graf's Slides
15-pages of accompanying slides, PDF download

Side-by-side comparisons of sensitive crystallisation, capillary dynamolysis, and circular-paper chromatography for different samples of food and the influence of farming practices.

Farming, Plant Nutrition and Food Quality
Jens-Otto Anderson - Research Assistant, University of Copenhagen
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[http://www.pmac.net/farming_nutrition.html]

The Renaissance of Farming Proceedings Located at:
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http://www.soilassociation.org/

There is a Difference! - Famous Chromatograms from Dr. Ehrenfried Pfeiffer

Galaxy Nutrients
http://www.galaxynutrients.com/Difference.html

Circular Chromatography Images: A Comparative Look at Natural vs Synthetic Products Using the 'Chroma' Method
Special Thanks to Human Dimensions Institute
http://ncatark.uark.edu/~steved/chromas.html

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Swedish University of Agricultural Sciences
http://zeus.bibul.slu.se/documents/slv/var_foda/VFA95-8/VFA95-8R.HTM

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Swedish University of Agricultural Sciences
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Swedish University of Agricultural Sciences
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What is Quality and How Can We Measure It?
Judith A. Abbott, USDA-ARS, Horticultural Crops Quality Laboratory,
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Producing and Marketing Quality Organic Products: Opportunities and Challenges
6th IFOAM Trade Conference: Quality and Communication for the Organic Market,
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http://www.fao.org/organicag/doc/IFOAMf-e.htm

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Historically Important Books on Nutrition and Diet from Weston Price & Francis Pottenger

The Price-Pottenger Nutrition Foundation
http://www.price-pottenger.org/

Weston Price's *Nutrition and Physical Degeneration*: Book review
By Steve Solomon at Soil and Health Library
http://www.soilandhealth.org/02healthlibrary/0203longevitycat/020305ppnf/PPNF.HTML

Weston Price's *Nutrition and Physical Degeneration*: A Potpourri of Price's Photos
By Steve Solomon at Soil and Health Library
http://www.soilandhealth.org/02healthlibrary/0203longevitycat/020305ppnf/PPNFpartII.html

Nutrition, Soil Fertility and Health Papers from Sir Albert Howard and Sir Robert McCarrison

Cheshire Medical Testament -- With testamony and letters of Albert Howard, Sir Robert McCarrsion and Lionel Picton
At Soil and Health Library
http://www.soilandhealth.org/02healthlibrary/0203longevitycat/020308testament.html

Nutrition and National Health
The Cantor Lectures, delivered before The Royal Society of Arts in 1936
By Sir Robert McCarrison
At Soil and Health Library
http://www.soilandhealth.org/02healthlibrary/0203longevitycat/020306mccarrision/mccarrison.html

FAO Documentation on Nutrition & Storage of Fruits, Vegetables, & Grains

1.
Chapter 2. General properties of fruit and vegetables; chemical composition and nutritional aspects; structural features

Fruit and Vegetable Processing
FAO Agricultural Services Bulletin No.119
http://www.fao.org/docrep/V5030E/V5030E00.htm

2.
Chapter 1.2. Food security, nutrition and health
1.2.1. Improvements to home processing and storage

Guidelines for Small-Scale Fruit and Vegetable Processors
FAO Agricultural Services Bulletin No. 127
http://www.fao.org/docrep/W6864E/W6864E00.htm

3.
Prevention of Post-Harvest Food Losses Fruits, Vegetables and Root Crops: A Training Manual
FAO Training Series No. 17/2
http://www.fao.org/docrep/T0073E/T0073E00.htm

4.
Post-Harvest Losses in Quality of Food Grains[Book Review]
FAO Food and Nutrition Paper No. 29 http://www.fao.org/icatalog/book_review/giii/W8857-e.htm

General Nutrition Information

Nutrition and Food on the Web - Finding the Right Stuff
Jean Fremont, RD. School of Kinesiology, Simon Fraser University
Burnaby, British Columbia, Canada
http://www.sfu.ca/~jfremont/

The Food and Nutrition Information Center (FNIC)
National Agricultural Library
http://www.nal.usda.gov/fnic/

USDA Food Composition Laboratory/Databases
http://www.nal.usda.gov/fnic/foodcomp/

USDA's Food Guide Pyramid Booklet
http://www.usda.gov/cnpp/pyrabklt.pdf

Minerals for Plants, Animals and Man
Alberta Agriculture, Food and Rural Development
http://www.agric.gov.ab.ca/agdex/500/531-3.html

Food Consumption & Diet-Health-Environment Connection

Guidelines for Personal and Environmental Health: A Report on Food Consumption in Canada and the Diet-Health-Environment Connection
by Jennifer Lombardi, BSc. McGill University
Special Topics Course, Supervised by J. Henning (April 1997)
http://eap.mcgill.ca/library/enig1.htm

Background Paper on Fertization and Crop Quality

Balanced Fertilization and Crop Quality
By R. Härdter and A. Krauss
IFA Agricultural Conference on "Managing Plant Nutrition"
Barcelona, Spain. 29 June - 2 July 1999
http://www.fertilizer.org/PUBLISH/barc23.pdf

Handbook on Organic Food Processing and Production

Handbook of Organic Food Processing and Production, Second Edition
Editors: Simon Wright, Diane McCrea
Blackwell Science, September 2000
http://www.blackwell-science.com/~cgilib/bookpage.bin?File=10012685

Response from the Food Industry

Current Hot Topics: Organic Food
Institute of Food Science & Technology
http://www.ifst.org/hottop24.htm

Organic Industry Groups Spread Fear for Profit; Report Details Multi-Decade, Ongoing Campaigns to Create Consumer Distrust and Fear Over Conventional Foods
http://www.NoMoreScares.com/news/organic.htm

Marketing & The Organic Food Industry: A History of Food Fears, Market Manipulation and Misleading Consumers
http://www.NoMoreScares.com/images/iea.pdf

The Hidden Dangers in Organic Food
American Outlook Magazine, Fall 1998
Dennis T. Avery
http://www.hudson.org/American_Outlook/articles_fa98/avery.htm

Organic Industry Response to Food Industry Media Spinners

Response to Dennis Avery's Criticism of Organic Food
By Tim Marshall, in *Acres Australia*
http://www.ofa.org.au/averymain.htm

Note: The nutritional quality of food raised by organic farming in comparison to conventional farming is a current topic that continues to attract interest and generate discussion. This document summarizes some of the viewpoints and provides a collection of *in-print* and *on-line* resources.

Conclusion: The author concludes that an organic food label, itself, does not insure superior quality, primarily due to the fact that supermarket produce is pooled from anonymous sources, and farm-to-farm and geographical variability with regards to nutritional composition of food is a certainty. There are many factors affecting the nutrition of food, including soil type, variety, and post-harvest handling. In addition, soil testing, mineral supplementation, and biological soil management are practices that vary from farm to farm.

Nevertheless, eco-labels exist to assure consumers that foods are produced according to ecological standards and guidelines, and organic labeled foods do meet these guideliness.

Lastly, the special attention to food quality inherent to the organic agriculture movement is fundamentally important to this discussion. Whether from the biodynamic, eco-farming, or organic persuasion, a large number of farmers and researchers have developed a keen insight into soil health and food quality, as well as novel and innovative methods of qualitative analysis. Hopefully, this knowledge will continue to evolve and lead to more widely accepted production techniques that are known, for example, to influence qualitative parameters like Brix, amino acid makeup and protein content, vitamin levels, biophoton emissions, flavor components, beneficial phytochemicals, etc.

If you have comments, suggestions, or resources to share on this material, please send them to: Steve Diver <steved@attra.org>

Compiled by:

Steve Diver
ATTRA Technical Specialist
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ATTRA Web Page
http://www.attra.org/

Rhizosphere II: Publications, Resource Lists, and Web Links from Steve Diver
http://ncatark.uark.edu/~steved/index.html
