NUTRITIONAL QUALITY OF ORGANIC VERSUS CONVENTIONAL FRUITS, VEGETABLES, AND GRAINS*

"Prior to the widespread use of pesticides, those in the health care community who advocated organic foods claimed that these foods contained a better arrangement of nutrients as a result of the superior soil management and fertilizer practices used by organic farmers. As a corollary, they cautioned that food grown with chemical fertilizers caused deleterious health in animals and humans."*

In NOHA we have been concerned for many years about the deleterious health effects from residues of pesticides on foods, or even just ingested in our water. For example in *NOHA NEWS*, Summer 1999, we reported on the research of Professor Warren P. Porter and colleagues, who gave their animals—just in their drinking water—tiny doses of pesticides, often used in agriculture, and nitrates which are ubiquitous from fertilizers in drinking water of people throughout the United States, especially in agricultural communities. With combinations at levels often found in our drinking water they found endocrine, immune, and behavioral effects in their mice.

In her research,* Dr. Worthington does not deal with pesticide and fertilizer contaminants in our food and water but, specifically, with the nutrient and toxic (heavy metal and nitrate) constituents of our food. She combines the research from all available studies that give numerical figures for organic content of specific nutrients and toxins in various foods, (37 papers) and uses 1,240 comparisons.

. . . tiny doses of pesticides, often used in agriculture, and nitrates which are ubiquitous from fertilizers in drinking water of people throughout the United States, especially in agricultural communities. With combinations at levels often found in our drinking water . . . endocrine, immune, and behavioral effects [were found] in . . . mice.

She considers 35 vitamins and minerals, nitrate content, and sometimes total mineral content when that is all that is available, plus protein quantity and quality.

For "conventional values" she uses the overall nutrient composition data for food from the U. S. Department of Agriculture, because "ninety-five percent (95%) of crops in the United States are now produced with chemical fertilizers and pesticides. . . . and producing crops using these chemicals has come to be known as conventional agriculture."

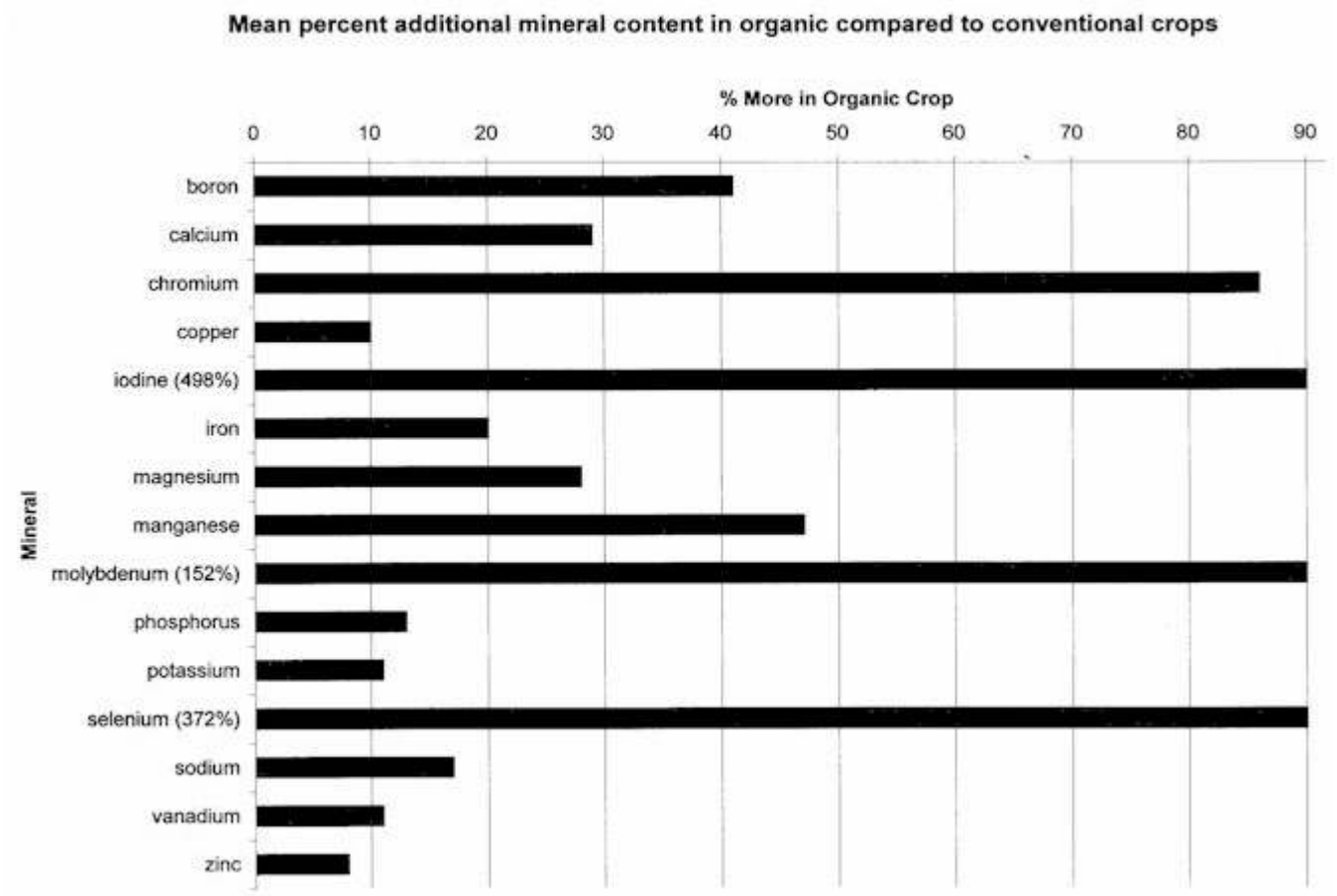
For each vegetable, fruit, and grain, using the figure for a specific year whenever possible, she takes from a study the figure for organic as a percentage change from the figure for conventional.

For the five most frequently studied vegetables, lettuce, spinach, carrot, potato, and cabbage, she gives average percent differences for four nutrients. In no case was there sufficient data for her to calculate statistical significance. However, the figures are interesting: "For example, vitamin C is 17% more abundant in organic lettuce (conventional 100%, organic 117%)." In the case of spinach, average vitamin C content is 52% higher. We must remember that in actual practice, much variability occurs, not just from the cultivation methods and soil care by organic farmers versus conventional but also from "uncontrollable factors such as rainfall and sunlight, which also influence nutrient content."

. . . "ninety-five percent (95%) of crops in the United States are now produced with chemical fertilizers and pesticides. . ."

Most nutrients were measured in very few studies, so, even with well over a thousand individual comparisons, there were only twelve nutrients with sufficient data for a statistical comparison. They were calcium, copper, iron, magnesium, manganese, phosphorus, potassium, sodium, zinc, beta-carotene, vitamin C, and nitrates. Of these only five, vitamin C, iron, magnesium, phosphorus, and nitrates, showed statistically significant differences. "For each of the significant nutrients, the organic crops had a higher nutrient content in more than half of the comparisons. For the one toxic compound, nitrates, the organic crop had a lower content the majority of the time."

Even although there were not sufficient data for more statistical analyses, in a descriptive sense there were many interesting findings: "First, there appear to be higher amounts of nutritionally significant minerals in organic compared to conventional crops."



Note that three of these bars would go way beyond the 90% increase!

"For all four heavy metals considered, the organic crop contained lower amounts of the heavy metals more often than comparable conventional crops." Interestingly, in regard to protein, the conventional crops tended to contain more protein but the quality was poorer.

Dr. Worthington points out supporting evidence for the superior results from organic farming practices. First of all, organic farmers fertilize their land with compost—plant wastes and aged animal manure. They rotate their crops so that one crop, for example a legume, can give nutrients to the next crop. In conventional farming, the same crop is often planted over and over again, which, of course, depletes the soil of all the particular nutrients needed by that crop. Sometimes, organic farmers have many plants growing together, which makes excellent fodder for animals. Sometimes the combination contains soybeans, which can be removed with special machinery and sold. The remaining plants are good food for animals, who do better without the soy. [Information from John Bell Clark, PhD, during a tour of Roseland Organic Farm, October 7, 2001, See also, *NOHA NEWS*, Winter 2002, "NOTES FROM AN ORGANIC FARMER."] Organic farming encourages soil organisms, which can produce "many compounds that help plants, including substances such as citrate and lactate that combine with soil minerals and make

them more available to plant roots. . . The presence of these microorganisms at least partially explains the trend showing a higher mineral content of organic food crops."

Organic farming encourages soil organisms, which can produce "many compounds that help plants, . . . [many] combine with soil minerals and make them more available to plant roots. . . The presence of these microorganisms at least partially explains the trend showing a higher mineral content of organic food crops."

On the other hand, the chemical fertilizers used in conventional agriculture contain just a few minerals, which dissolve quickly in damp soil and give the plants large doses of the minerals—just at one time and often more than is needed. For example, in the case of nitrogen, Dr. Worthington explains how:

Nitrogen from any kind of fertilizer affects the amounts of vitamin C and nitrates as well as the quantity and quality of protein produced by plants. When a plant is presented with a lot of nitrogen, it increases protein production and reduces carbohydrate production. Because vitamin C is made from carbohydrates, the synthesis of vitamin C is reduced also. Moreover, the increased protein that is produced in response to high nitrogen levels contains lower amounts of certain essential amino acids such as lysine and consequently has a lower quality in terms of human and animal nutrition. If there is more nitrogen than the plant can handle through increased protein production, the excess is accumulated as nitrates and stored predominately in the green leafy part of the plant. Because organically managed soils generally present plants with lower amounts of nitrogen than chemically fertilized soils, it would be expected that organic crops would have more vitamin C, less nitrates and less protein but of a higher quality than comparable conventional crops.

Potassium fertilizer can reduce the magnesium content and indirectly the phosphorus content of at least some plants. When potassium is added to soil, the amount of magnesium absorbed by plants decreases. Because phosphorus absorption depends on magnesium, less phosphorus is absorbed as well. Potassium is presented to plants differently by organic and conventional systems. Conventional potassium fertilizers dissolve readily in soil water presenting plants with large quantities of potassium while organically managed soils hold moderate quantities of both potassium and magnesium in the root zone of the plant. Given the plant responses just described, it would be expected that the organic crops would contain larger amounts of magnesium and phosphorus than comparable conventional crops.

Some chemical fertilizers also contain toxic heavy metals. "Phosphate fertilizers often are contaminated by cadmium. Also, trace mineral fertilizers and liming materials derived from industrial waste can contain a number of heavy metals." Since these toxins would build up in the soil and contaminate plants, the finding of more heavy metals in conventional food might be expected.

Before World War II chemical fertilizers and pesticides were virtually unused. Some warnings about adverse health effects were ignored and farmers were encouraged . . . to abandon the old practices . . . and buy the easy-to-use chemicals. We are beginning to accumulate information on problems: "Animal studies suggest that such functions as reproduction and resistance to infection might be adversely affected . . ." A study on humans "reported that the percentage of normal sperm increased as the percentage of organic food in men's diets increased."

Before World War II chemical fertilizers and pesticides were virtually unused. Some warnings about adverse health effects were ignored and farmers were encouraged by much advertising and by advice from their County Agents to abandon the old practices, be modern, and buy the easy-to-use chemicals. We are beginning to accumulate information on problems: "Animal studies suggest that such functions as reproduction and resistance to infection might be adversely affected by conventionally produced foods as compared to organically produced ones." A study on humans "reported that the percentage of normal sperm increased as the percentage of organic food in men's diets increased."