International Journal of Agriculture and Food Science Technology.
ISSN 2249-3050, Volume 4, Number 4 (2013), pp. 379-384

http://www.ripublication.com/ ijafst.htm

Food Micro-nutrients & Organic (Natural) Farming

Muralidhar Acharya M.S, M.D (Alt.Med.) and Krishi Yoga Kendra

Principal Scientist, Sai Maruthi Residency, # 203, Road # 1, 5th Cross, Rock Town Colony, L.B. Nagar, Hyderabad, A.P-500064.
E-mail: mkontham@gmail.com

Abstract

The Activities of the wide range of organisms in soil play an important role in natural ecosystems. Their processes contribute to the soil's health, ability to retain nutrients and make them available for plant. Soil biological, physical and chemical processes are interrelated and all contribute to plant health & productivity. The chemical and physical environment in soil will influence the biological processes and subsequently the soil fertility. Soil organic matter and micro organisms play pivotal role not only in macronutrients but also micronutrient availability for plants. Soil organic matter and Microorganism populations are significantly lower in conventionally farmed soils than organic (natural) farm lands. There are hundreds of micronutrients including trace minerals required for healthy growth of a plant. The soil that is deficient in micro nutrients will give rise to deficiency in micro nutrients in plant produce. While the amount of micronutrients will vary, organic produce show higher levels of vitamin C, Iron, Magnesium, Phosphorus and Antioxidant Phytochemicals.

1. Introduction

Agriculture Revolution (Borlaug 1983), conventional global food production systems are not providing sufficient food micronutrients (Welch 2002). Over 40% of the world's population is currently micronutrient deficient, resulting in numerous health problems, inflated economic costs borne by society, and learning disabilities for children (Sanchez and Swaminathan 2005). Though a diversification of diet to include micronutrient rich traditional foods is a preferred solution to these challenges, cereal grains are the primary dietary source of micronutrients for much of the world's population (Bouis 2003). Organic crops contain a significantly higher amount of

certain antioxidants (vitamin C, polyphenols and flavonoids) and minerals, as well as have higher dry matter content than conventional ones (Györéné KG 2006).

A widely accepted definition of soil quality is the capacity of a soil to sustain biological productivity, maintain environmental quality, and promote plant and animal health (Doran JW 1994). Soil quality may be inferred from measurable soil properties termed soil quality indicators (Reganold, 1993). Organic farming practices compared to conventional farming practices have been shown to improve soil quality indicators based on traditional measures of biological, chemical, and physical properties (Reganold 2001, Mäder P 2002). The abundances of soil micro organisms involved in C/N/P/S cycles were consistently higher in organic farming systems than in the conventional system, more over organic farming system sustaining higher soil microbial community diversity and potentially enhance functions mediated by soil microbes in nutrient cycling (Kai Xue 2013)

2. Micronutrients content in food

2.1 Vitamins & Minerals

The nutrient density of many common foods has declined gradually over time in both the U.S. (Davis, et al. 2004) and the U.K. (Mayer 1997; White and Broadley 2005). The team led by Dr. Don Davis, University of Texas-Austin, examined Changes between 1950 and 1999 in USDA food composition data for 43 garden crops. They found significant declines in median concentrations of six nutrients: protein (Pro), calcium (Ca), phosphorus (P), iron (Fe), riboflavin (Rib) and vitamin C (Vit C), as shown in Figure 1. Declining average nutrient levels in the U.S. food supply have been brought about by what agronomists have labeled the “dilution effect,” first coined in an important review article published in 1981 (Jarrell and Beverly 1981).

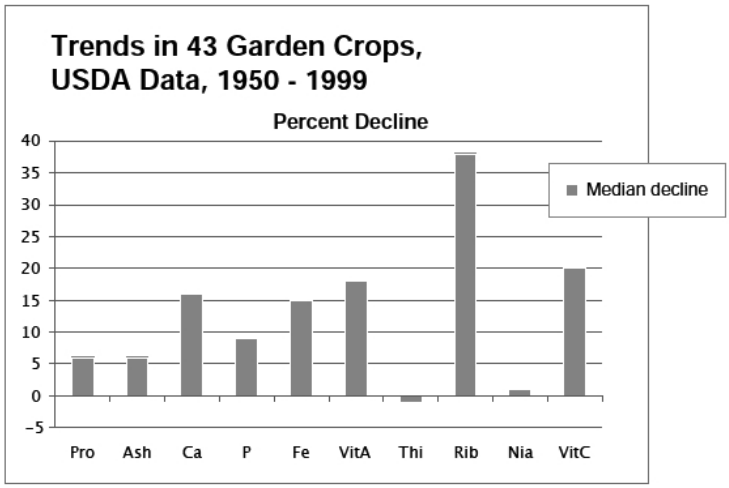

Figure 1: Showing decline in micronutrient content.

The remarkable increases in per acre crop yields brought about over a half-century through advances in plant Breeding, the intensity of fertilizer and pesticide use, and irrigation are well known. However, few are aware that this achievement has come at a cost in terms of food nutritional quality.

A comparison of mineral and vitamin levels in food produced with organic and conventional fertilizers was published in the *Journal of Alternative and Complimentary Medicine* by Virginia Worthington and has been widely cited because of its simple, straightforward approach and findings. Worthington focused on studies of fertilizers and food nutrient levels because "fertility management is historically the most fundamental difference between organic and conventional agriculture." The Wilcoxon signed-rank test was used to identify statistically significant differences in nutrient levels across 41 published studies encompassing 22 replicated field trials, four simple field trials, four greenhouse pot studies, four market basket surveys, and eight surveys of commercial farms or home growers. Twelve nutrients were analyzed, most of them minerals. Four nutrients were significantly higher in organic food than in conventional food, while one "toxic" substance (nitrate) was significantly lower (a desirable difference) in organic food. The nutrients studied and percentage differences of organic food relative to conventional foods were:

- Vitamin C, +27%
- Iron, +21%
- Magnesium, +29%
- Phosphorous, +14%
- Nitrates, -15%

Data was presented reporting the range of differences in nutrient levels in a variety of vegetables. Evidence also indicated a trend toward higher protein levels in conventional food, but higher quality protein in organically grown foods. (The balance of amino acids in protein determines its "quality" in terms of meeting human nutritional needs).

Various reviews on nutritional differences between organic and non-organic foods have been punished in recent past. Earlier studies looked primarily at the mineral and vitamin content, while recent studies look at phytochemmicals in the foods. Lairon D. (2009) review reported that regarding minerals, organic foods have 21- percent more iron and 29-percent more magnesium than non-organic foods. When vitamins were studied, ascorbic acid was most common vitamin found in higher quantities in many organic fruits and vegetables tested. Worthington V. (2001) reached much the same conclusion, stating that four nutrients were found in significantly higher levels in organic produce – ascorbic acid averaged 27-percent higher, iron 21-percent higher, magnesium 29-percent higher, and phosphorus 13.6-percent higher. Grain mineral concentration was higher in organic systems than conventional systems for Cu, Mg, Mn, P and Zn. Only Ca had a higher grain concentration in conventional systems than in organic systems (Murphy K. 2008).

2.2 Phytonutrients

Science has made great progress in understanding the importance to human health of a range of secondary plant metabolites, many of which are essential vitamins and health-promoting antioxidants. According to Harborne (1999), secondary plant metabolites can be divided into four classes:

- Phenolic compounds (e.g., flavonoids and phenolic acids),
- Terpenoids (e.g., carotenoids and limonoids),
- Alkaloids (e.g., indoles), and
- Sulfur-containing compounds (e.g.,glucosinolates).

In the last 20 years the importance of the phytonutries content of the foods has been established. Because of the health benefits of the phytonutrients, they have been the focus of much recent research on the nutritional value of organic foods. Organic produce shown to contain higher levels of phytonutrients Table 1.

Table 1: Phyto nutrient content of organic foods with higher levels then conventional foods.

Food	Nutrients Tested	Ref.
Potatoe	Ascorbic acid & Chlorogenic acid	Hajslova J, (2005)
Blueberries	Sugars, malic acid, phenolics & antiaxicents	Wang Sy, (2008)
Strawberries & corn	Ascorbic acid & Chlorogenic acid	Asami DK, (2003)
Grape Juice	Total Polyphenols: resveratrol	Dani C, (2007)
Plums	Ascorbic acid	Lambardi-Boccia G, (2004)
Oranges	Polyphenols, Anthocyanins & Ascorbic acid	Tarozzi A, (2006)
Wheat	Protein & Starch	Nitka, (2008)
Milk	Omega-3 fatty acids	Ells KA, (2007)

3. Conclusion

There is general decline in micro-nutrients in food over the past fifty years, owing to conventional chemical methods of farming. There is mounting evidence showing the higher micro-nutritional quality of food in natural organic produce than in conventional chemical based farm produce. It is plausible that increased root colonization by the Micro-organisms present in organic fields with higher percent organic matter may have resulted in enhanced uptake of soil nutrients and higher micro-nutrient concentration in produce.

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