

## Science Confirms the Nutritional Superiority of Plant-Based Organic Food



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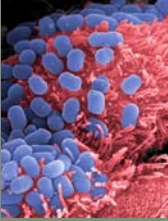
## Major Differences Between Organic and Conventional Food

Three of five major food safety concerns largely eliminated:

- Pesticides
- Animal drug residues/antibiotic resistance
- GM food risks (e.g., novel allergens)

Organic farming can help manage the two other major food safety risks:

- Mycotoxins
- Bacterial contamination



## Major Differences Between Organic and Conventional Food and Farming

**Worker Safety**

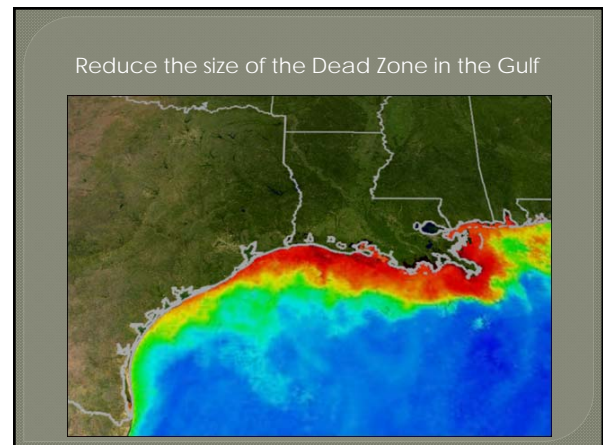
**Environmental Impacts**

- Build soil quality
- Increase terrestrial carbon sequestration
- Promote biodiversity
- Lower energy inputs

Reduce impacts on birds, fish, pets, small mammals

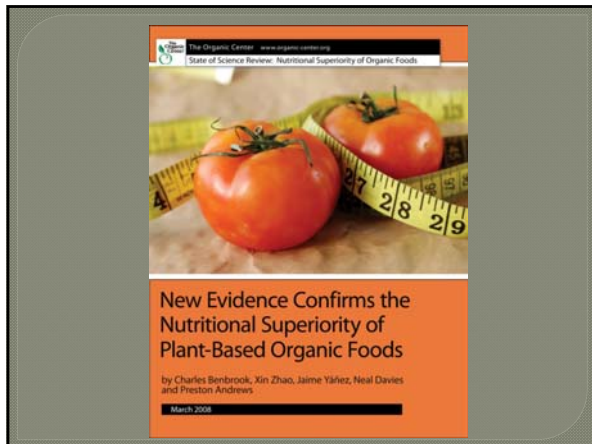
Increase N use efficiency

Reduce the size of the Dead Zone in the Gulf

**Do scientifically valid comparative studies of the nutrient content in organic and conventional foods favor organic, conventional (or neither) production system?**

**What is the magnitude of differences for key nutrients between organic and conventional foods?**




### A rapidly expanding database to compare nutrient density

	2007	2006	2005	2004	2003	2002	2001	2000	1999-1995	1994-1990	1989-1980	Pre-1980	Total
Number of Published Studies	10	7	15	8	4	1	5	5	14	11	8	0	88

45% of the included studies were published 2004 through September 2007  
 55% of studies – 1980 through 2004

Approximately 10-15 new studies per year are anticipated, half in the *Journal of Agricultural and Food Chemistry*

### Matched Pairs




17 rules used to guide the selection of matched pairs.


Needed to minimize or eliminate factors that could confound, mask or skew real differences in nutrient levels

### Agronomic Practices Screen

- Cultivar
- Production methods
- Location
- Soil type and topography
- Nutrient levels and fertilization
- Pest control
- Cultural practices



### Analytical Methods Screen



Focus on individual methods by food and/or crop

Published methods acceptable, unless reported methods raise questions, e.g.

- Baseline resolution
- Separation

CV or RSD <16% or bias percentile lower than 12%

Outlier values trigger additional investigation



**VITAMINS**  
 Matched pairs = 67

Organically grown higher = 41  
 Conventionally grown higher = 26



**MINERALS**  
 Matched pairs = 65  
 Organically grown higher = 34  
 Conventionally grown higher = 29



**ANTIOXIDANTS**  
 Matched pairs = 59  
 Organically grown higher = 44  
 Conventionally grown higher = 13


**Overview of differences in the nutrient content in the organic and conventional foods in 236 matched pairs**

Nutrient Class	Number of Matched Pairs	Number Organic Higher	Number Conventional Higher
Antioxidants	59	44	13
Vitamins	67	41	26
Minerals	65	34	29
Nitrates	18	3	15
Protein	27	4	23



**Results overview**


- Out of 236 valid matched pairs, organic foods were nutritionally superior in 61% of the cases.
- Organic samples contained higher concentrations of polyphenols and antioxidants in 75% of the matched pairs representing those nutrients.




**MAGNITUDE of the DIFFERENCES in NUTRIENT CONTENT**

**ON AVERAGE IN THE ORGANIC SAMPLES –**

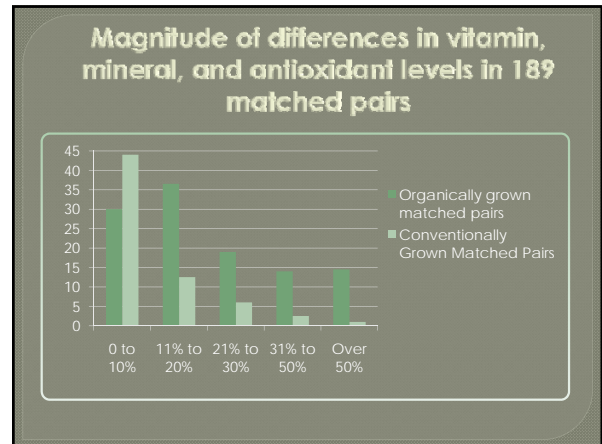
TOTAL ANTIOXIDANT CAPACITY was 88% higher  
 TOTAL PHENOLICS, 72% higher  
 QUERCETIN, 87% higher  
 KAEMPFEROL, 55% higher




PROTEIN was 85% higher in the conventional samples



NITRATES were 83% higher in the conventional samples



### Key new studies published after the March 2008 report




S.H. Wang et al., "Fruit Quality, Antioxidant Capacity, and Flavonoid Content of Organically and Conventionally Grown Blueberries," *Journal of Agricultural and Food Chemistry*, published on web July 1, 2008.



F. Beltran-Gonzalez et al., "Effects of agricultural practices on instrumental colour, mineral content, carotenoids composition, and sensory quality of mandarin orange juice, cv. Hermandina," *Journal of the Science of Food and Agriculture*, 2008

### Why are organic fruits and vegetables generally more nutrient dense?


- Dilution effect
- Growth patterns and rate
- Plant defenses and response to stress
- Impacts of nitrogen on sugar levels and metabolism





### The Dilution Effect

Term was first used in *Advances in Agronomy*, WM Jarrell WM, RB Beverly, 1981; 34:197-224.


For more see "*Still No Free Lunch: Nutrient Levels in the U.S. Food Supply Eroded in Pursuit of Higher Yields*", by Brian Halweil, available from the Organic Center website - [www.organic-center.org](http://www.organic-center.org)




### Plant Defenses and Response to Stress

Yield-enhancing methods tend to decrease nutrient concentration



### 2008 Research at Washington State University on Tomatoes, Yields, and Nutritional Quality

Greenhouse pot study

Organic and conventional systems


Heirloom and modern varieties

Multiple levels of nitrogen

*Preliminary Results -*

- In conventional system, larger fruit contained lower nutrient levels, consistent with the dilution effect.
- In organic system, larger fruit retained same nutrient density as smaller fruit.


First evidence that organic management might push up yield levels where the dilution effect starts to erode nutrient density.



### Impacts of nitrogen on sugar levels and metabolism

Conventional systems dependent on high nitrogen fertilization rates will produce:

- Faster growth, bigger fruit, larger average cell size (factors leading to the 'dilution effect')
- Higher levels of protein and nitrates
- Less intense flavors and shorter shelf life
- Greater susceptibility to pathogens and insects




### Impacts of high - N production systems on fresh produce


- More sugar and moisture
- Greater percentage of nutrients in glycosylated form, plus, in many cases, more complex and stable forms of glycosylation

*Key Question -*

Do plants suffer from a diabetes-like syndrome?




### Human Health Implications of High N Systems



- Reduced bioavailability of nutrients
- Insulin resistance and increased risk of diabetes
- More Advanced Glycation Endproducts (AGEs) in the food supply, especially burnt and/or fried foods

### Relationships Between Diabetes Mellitus and Plants with a Diabetes-Like Syndrome

Diabetes - Like Syndrome	Diabetes Mellitus
Driven by excess sugars caused by high nitrogen fertilization	Driven by excess sugar and calories in diet and abnormal sugar metabolism
Excess sugar triggers physiological changes that can increase vulnerability to pathogens and insects	Excess sugars trigger vascular changes that can lead to multiple complications, including increased risk of infectious disease



### Good News for Human Health

Nutrient dense organic fruits and vegetables can reduce the total calories needed to meet daily nutrient needs.



### Good News for Human Health

More intense flavors in organic produce may help trigger satiety, lessening the tendency toward excessive caloric intake



### Emerging Research Opportunities

USDA Integrated Organic Program "Request for Proposals" opens new areas of research

Up to \$18 million available in FY 2009, proposals due March 9<sup>th</sup>

Organic Center interest in establishing the science base for "qualified health claims" under the "FDA Modernization Act"



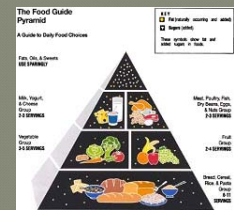
### Possible Qualified Health Claims to Pursue

Reduced pesticide risks in children's fresh and processed fruit and vegetable products

Total phenolics and/or lycopene in processed tomato products

Higher vitamin and antioxidant content in organic vegetable oils, coupled with possibly lower levels of AGEs (Advanced Glycation Endproducts)

Elevated CLAs and omega-three fatty acids in organic milk and dairy products



*Can you suggest other candidates?*

A Last Thought – Increasing soil and human health should be the goal of farmers and the food industry, not just increasing yields.



Thank you for your attention.

Presentation posted at – [www.organic-center.org](http://www.organic-center.org)