New Evidence Confirms the Nutritional Superiority of Plant-Based Organic Food

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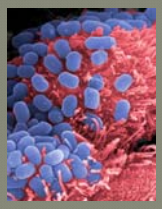
ORGANIC or CONVENTIONAL FOODS -- More nutritious? Better for the environment?

Major Differences Between Organic and Conventional Food and Farming

Three of five major food safety concerns largely eliminated
- Pesticides
- Animal drug residues/antibiotic resistance
- GM food risks (e.g., novel allergens)

Help manage two other major food safety risks:
- Mycotoxins
- Bacterial contamination



Major Differences Between Organic and Conventional Food and Farming

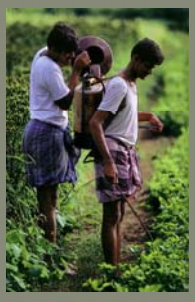
Worker Safety

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



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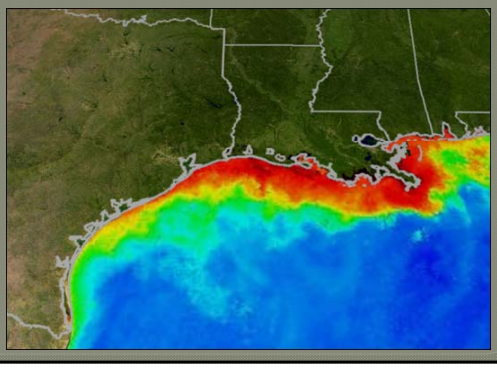
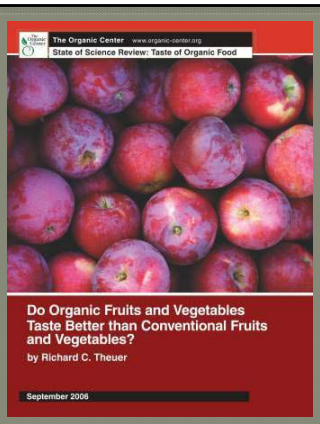
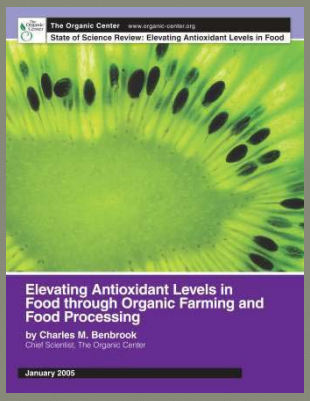
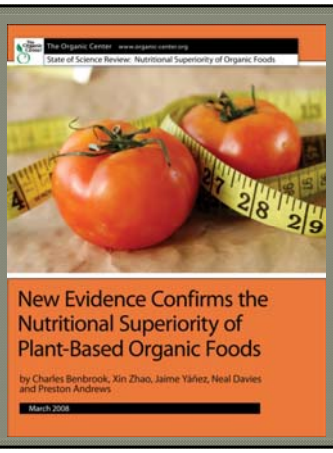




Organic production often improves organoleptic quality



Organic production increases average antioxidant levels by ~ 25%



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

Number of Peer-Reviewed Studies Comparing the Nutrient Content of Organic and Conventional Food

	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

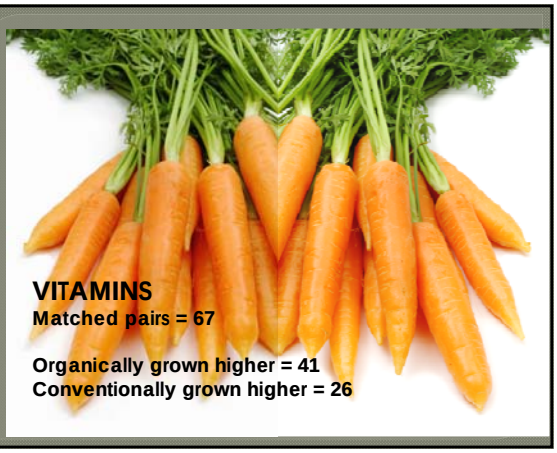
Analytical Methods Screen

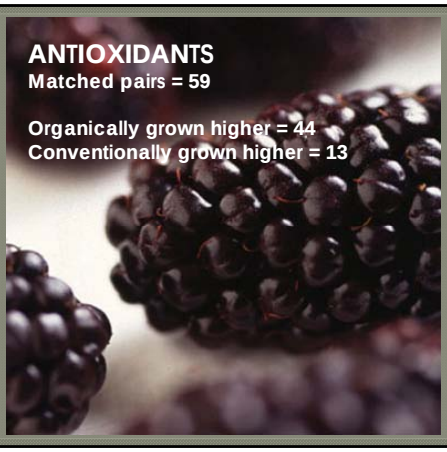
Focus on individual methods by food and/or crop

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





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

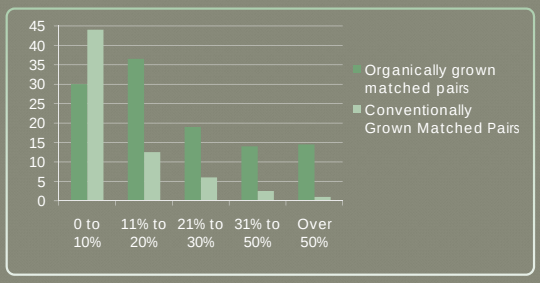
ON AVERAGE IN THE ORGANIC SAMPLES –

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

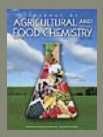
PROTEIN was 85% higher in the conventional samples

NITRATES were 83% higher in the conventional samples

Magnitude of differences in vitamin, mineral, and antioxidant levels in 189 matched pairs



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. Hernandina,"** *Journal of the Science of Food and Agriculture,* 2008

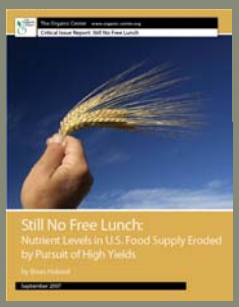
Why are organic fruits and vegetables generally more nutrient dense?

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

The Dilution Effect

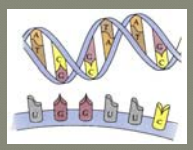
Term was first used in ***Advances in Agronomy***, WM Jarrell WM, RB Beverly, 1981; 34:197-224.

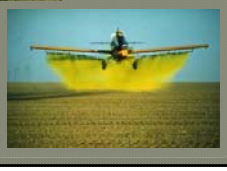
For more see ***"Still No Free Lunch: Nutrient Levels in the U.S. Food Supply Eroded in Pursuit of Higher Yields",*** by Brian Halweil , available from the Organic Center website – www.organic-center.org



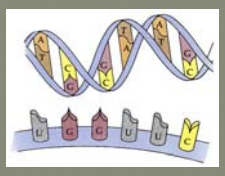
Yield-enhancing methods tend to decrease nutrient concentration

Factors that often decrease nutrient density



Factors that often increase nutrient density





Plant defenses and response to stress


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, carotenoids, 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, less Vitamin C
- Greater percentage of nutrients in glycosylated form, plus often more complex and stable forms of glycosylation

Human Health Implications

- 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

Looking Ahead

Role of plant breeding and GM foods?

Renewed focus on food quality-health linkages?

Policy changes reward farmers for food quality enhancement?

Will Americans recognize the limits of therapeutic interventions, and need to invest in preserving good health?

Presenter Disclosures

Charles M. Benbrook, Ph.D.

(1) The following personal financial relationships with commercial interests relevant to this presentation existed during the past 12 months:

Food Safety Technical Advisory Board
Earthbound Farms

Is increasing yield *REALLY* the ultimate goal?

Thank you for your attention

More information:
www.organic-center.org