Organic Food and Nutritional Value: Current Research on the Benefits of Organic Food

Annual Meeting
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Salem, Oregon

PRESENTED BY:
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The Organic Cent

Differences in Conventional and Organic Food

What are the differences between conventional and organic food?

To what extent do these differences matter?

How do people place an economic value on the differences?

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

Differences Between Organic and Conventional Food and Farming

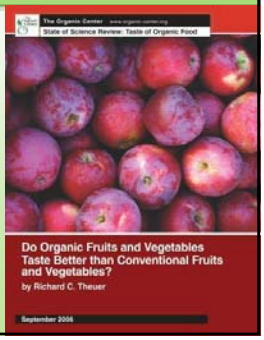
- Worker safety
- Environmental impacts:
  - Build soil quality & increase terrestrial carbon sequestration
  - Promote biodiversity
  - Lower energy inputs
- Reduce impacts on birds, fish, pets, small mammals
- Increase N use efficiency, reduce the size of the Dead Zone in the Gulf

Organic Production Improves Organoleptic Quality

Results from three continents show higher organoleptic quality in organic apples

TOC-funded WSU strawberry fruit quality project found positive differences in strawberries (out soon)

Ripeness, handling always critical in both systems

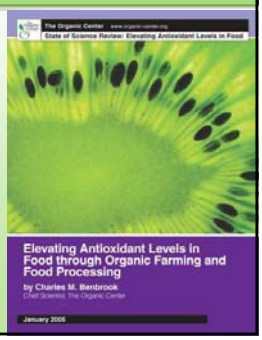


Organic Production Increases Average Antioxidant Levels

Antioxidant dietary intake is about one-third optimal levels

Total antioxidant capacity averages ~ 30% higher in organic foods

Individual antioxidants sometimes are 50% to 1-X or more higher



U.C. Davis Processing Tomato Study

"Qualitative and Nutritional Differences in Processing Tomatoes Grown under Commercial Organic and Conventional Production Systems"

By: Diane Barrett, Craig Weakley, M. Watnik

Journal of Food Science, Vol. 72, Nr. 9, 2007, pages 441-451

U.C. Davis Processing Tomato Study

- Four farms with both conventional and organic acreage, experienced, top-notch growers
- Detailed soils data
- Multiple quality parameters, both nutrition-related and processing
- Yields, input use

Processing Tomato Study Findings

- Yields essentially the same in conventional and organic fields
- Higher brix, soluble solids on organic fields
- Lycopene higher on two conventional, two organic fields
- Ascorbic acid higher conventional

Processing Tomato Study Findings

- Higher catsup yield from organic fruit
- Less energy to complete processing with organic fruit, lower processing costs (lower moisture content; higher solids)

- No significant flavor differences
- Impact of soil parameters mixed, and requires more study, but…

Processing Tomato Study Findings

- Higher quality soil on Rominger fields produced CON and ORG crops with ***no*** nutritional differences in lycopene, ascorbate acid, and phenolics
- Two other farms, these three nutrients higher in CON, and one one farm, no difference

- Rominger farm soil was silty clay loam, other farms had higher sand and/or clay content

Key Conclusions: U.C. Davis Study

- There were key quality advantages for tomato processors when working with organic fruit
- Yields of tomatoes and catsup higher in the organic system
- Complex interactions between soils, production practices (i.e., irrigation methods, tillage), and genetics
- Potential exists to change positive and negative quality attributes through production system innovation – for the benefit of organic and conventional growers

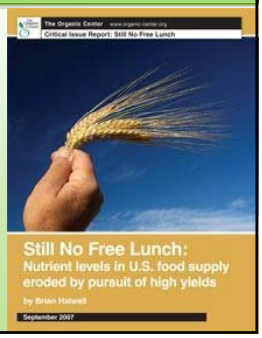
Conclusions from WSU Apple and Strawberry Studies

- Organic yields are often lower and fruit size smaller, but fruit stores and tastes better
- Organic apples are as firm or firmer, and organic strawberries are sweeter
- Organic fruit has, on average, higher antioxidant activity and polyphenol content

"Still No Free Lunch" Critical Issue Report, September 2007

Impacts of rising yields on nutrient density – multiple lines of evidence

Highlights role of high-nitrogen systems in boosting yields and protein levels, but diluting vitamins, antioxidants, and flavor



The Dilution Effect

- Yield-enhancing methods tend to decrease nutrient concentrations
- Term first used in Jarrell WM, Beverly RB, *Advances in Agronomy*, 1981; 34:197–224; brought back by Don Davis circa 2004

Comparing Nutrient Density in Conventional and Organic Systems

85+ published studies since 1980 compare nutrients in conventional and organic food

Studies need to be screened for experimental design, agronomics, soils, and analytical methods

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

Sept 2007-2004 = 40 45%
Pre-2004 = 48 55%

About 10-15 new studies per year likely, half in JFAC!!

Source: Unpublished findings, The Organic Center

Preliminary Findings on Nutrient Density

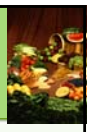
Among vitamins –

- Organic production typically increases Vitamin C, but often reduces beta-carotene

Among minerals –

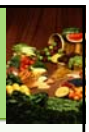
- Organic production typically increases some minerals and reduces nitrates (a good thing), nitrates are usually elevated in high-N systems

Preliminary Results on Nutrient Density



- Organic production typically increases total phenolics and antioxidant activity
- Often, a greater portion of phytochemicals are present in the aglycone form (no sugar attached), likely enhancing bioavailability

Chiral Flavonones in Citrus – WSU Study



- Neal Davies lab, with support the Center, measured chiral flavonones in citrus juices – hesperetin, naringenin, and eriodictyl
- Measured both the chiral forms, and aglycone and glycosylated forms
- Chiral structure and glycosylation status can impact bioavailability

Chiral Flavonones in Citrus – WSU Study

- Organic lemonade had 10-times the eriocitrin (glycoside form of eriodictyl) and organic lime juice 3-X higher levels
- Organic apple had higher levels (3-X, 2-X) of the two forms of hesperetin
- No significant differences in many of the nutrient forms studied… but

Chiral Flavonones in Citrus – WSU Study

- Organic grapefruit juice had 20% lower level of the glycoside form of hesperetin, but 77% more of the aglycone form
- A project using standard analytical methods would not pick up both forms, and could lead to erroneously conclusions
- Glycosylation status is impacted by sugar levels and metabolism in plants, and is impacted by production systems

Impacts of Organic Farming on Food Nutritional Quality

Better understanding needed to design and manage “nutrient-dense farming systems”

Conventional (or organic) high-nitrogen production systems likely to produce higher yields and levels of protein and some vitamins, but at the expense of flavor, antioxidant capacity, and storage stability

Implications for Human Health

Consumption of organic food largely eliminates pesticide dietary exposure, clearly reducing risks of birth defects and neurological problems

How much is peace of mind worth?

Implications for Human Health

Nutrient dense organic fruit and vegetables reduce the number of calories required to meet daily nutrient needs –

- 30-X or more antioxidants per serving compared to low nutrient dense foods
- Only 10% to 15% of total caloric intake needed to meet most nutrient needs
- Possible benefits for sugar metabolism

Source: Organic Center Antioxidant SSR

Implications for Human Health

Increased levels of some antioxidants in organic produce – e.g. resveratrol – appear to help trigger satiety:

- More intense flavors in organic produce, especially when picked ripe, may also lessen tendency toward excessive caloric intake
- Better tasting fruits and vegetables reduce waste

Critical Areas of Inquiry

Impacts of organic farming on sugar levels and metabolism in plants ***and*** people

Do plants sometimes suffer from a diabetes-like syndrome?

Sugar Levels and Metabolism in Plants

Conventional systems dependent on high nitrogen fertilization rates produce –

- Faster growth, bigger fruit, larger average cell size – factors leading to the "dilution effect"
- Higher levels of protein and nitrates

But also less value per ounce –

- Less intense flavors and shorter shelf life
- Greater susceptibility to pathogens and insects

Environmental Benefits of Organic Farming

- Virtually eliminate ecotox impacts of pesticides
- Build soil organic matter
- Tighten nitrogen cycle and increase N-use efficiency

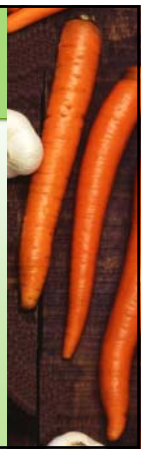
- Sequester carbon to slow global climate change

Final Thoughts

Many people are willing to pay a premium for the nutrient density and food safety/environmental benefits of organic food…

…but the magnitude and acceptability of the premium will change in response to whether and how conventional agriculture acts to narrow perceived differences

Looking Ahead



Taste, nutritional quality, and food safety benefits of organic farming could be eroded, in some crops, if organic farmers strive to attain conventional yields –

- High N organic systems are likely to also suffer from the dilution effect
- Pushing organic systems to match conventional yields could jeopardize soil quality and biodiversity-based benefits

Looking Ahead

Today's focus on comparative levels of individual nutrients is likely missing the full impact of plant breeding and alternative production systems –

- Key role of ratios and balances among nutrients in plants and people
- Organic food may present nutrients in more balanced, and bioavailable, "packages"
- More science needed to fully document and quantify the organic "premium"

Is the Organic Premium Worth It?

Consumers will provide the answer

The added value attached to organic food reflects:

- Absence of risky inputs used on conventional farms
- Greater nutrient density and better tasting food
- More humane animal care

Thank you.

More Information and Sources

Data and findings from the scientific reports f the Center, all available free from the Organic Center website: www.organic-center.org

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