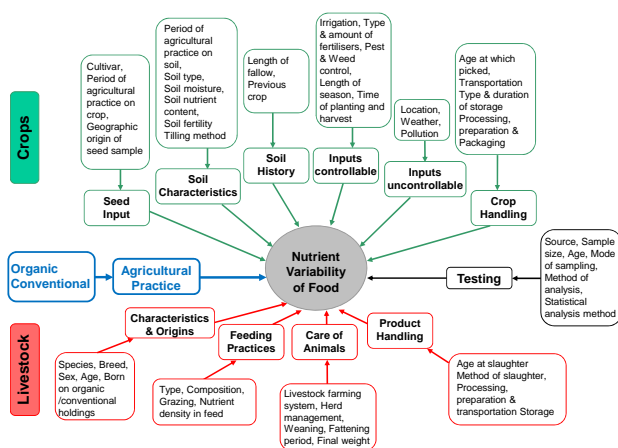
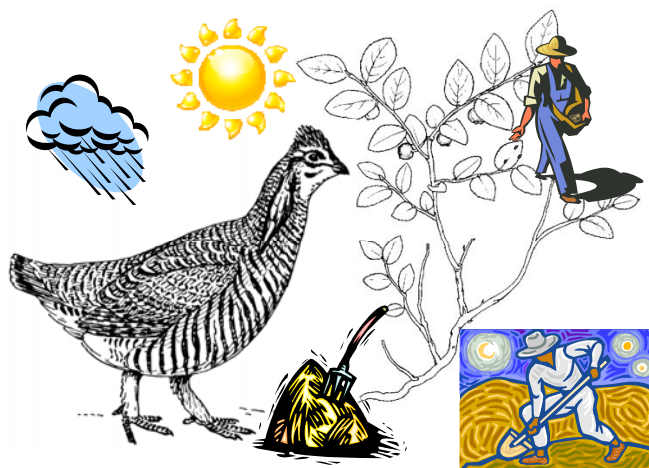


Nutrient content and health benefits of organic food: systematic reviews

Alan D Dangour

A. Aikenhead, E. Allen, S. Dodhia,

A. Hayter, K. Lock, R. Uauy



Previous nutrient content reviews

Author	Peer-reviewed?	Systematic?	Finding
Worthington, 2001	YES	NO	Organic better
Brandt, 2001	YES	NO	Some differences
Soil Association, 2001	NO	NO	Organic better
Bourne and Prescott, 2002	YES	NO	No difference
Kouba, 2003	YES	NO	No difference
Organic Centre, 2008	NO	NO	Organic better

- Important question, but uncertain answer
- No independent systematic review of evidence on nutrient content

What are systematic reviews?

- Focused on clearly defined question
- Explicit and pre-defined methods
- Comprehensive data search
- Unbiased selection and abstraction
- Critical appraisal and valid synthesis of data
- Used internationally for over 20 years to define public health policy

Food Standards Agency systematic review requirements (PAU221)

1. to identify and evaluate all relevant studies that compare the nutrient content of organic and non-organic food
2. to assess study strengths and weaknesses
3. to carry out a comprehensive review of the body of evidence as a whole, identifying whether and where any nutrient and non-nutrient compositional differences occur
4. to assess whether any proven nutrient or non-nutrient compositional differences have any nutritional or other health significance in the context of the overall diet

LSHTM review process

- Tendered for FSA contract December 2007
- Total budget £120,000
- Initiated reviews February 2008
- External independent expert review panel
- Reviews independent
- Update meetings with interested parties
- Reviews completed April 2009
- First review published in July 2009

Systematic review 1: Nutrient Content

- Pre-specified question
“Is there a difference in nutrient content between organically and conventionally produced foods?”
- Not reviewed
 - pesticide/herbicide residue content
 - impact on the environment
 - impact on biodiversity
 - animal husbandry
 -

Review protocol

- Protocol peer-reviewed and posted on-line in April 2008
- Pre-specified
 - research question
 - search strategy
 - inclusion/exclusion criteria
 - quality criteria
 - cut-off date

Searching for studies

A comprehensive list of terms

- agricultural / farming techniques
- foods / diets
- nutrients / nutritionally-relevant substances

The most recognised science databases

- PubMed
- Web of Science
- CAB Abstracts

Inclusion/exclusion criteria

As inclusive as possible

- direct organic vs. conventional comparison
- all study types
- English abstract
- published from 01/01/58 to 29/02/08

But we did exclude

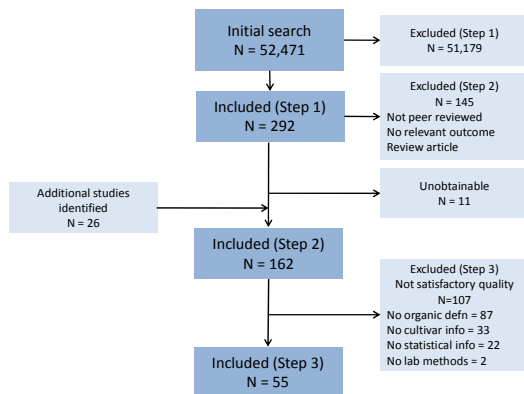
- non-peer reviewed studies
- review articles

Pre-specified quality criteria

Satisfactory quality studies must

- define “organic”
- state cultivar of crop, or breed of livestock
- state nutrient(s) analysed
- describe laboratory methods
- state statistical methods

Flow of studies in review



Available data

Mountainous...

- 3 different study designs
- 100 different foodstuffs analysed
- 455 nutrients or other compounds analysed
- 3500+ nutrient comparisons

...but great variability in reporting

Example: Calcium

- **Reported in three different study designs**
 - field trials, farm studies, basket surveys
- **Analysed in huge range in foods**
 - apple, banana, beetroot, cabbage, carrot, celeriac, grapefruit, kiwifruit, mandarin, oat, onion, pea, pear, plum, potato, pumpkin, rice, rye, savoury herb, strawberry, sweet pepper, sweet potato, sweet corn, tomato, wheat
- **No standard methods of analysis**
 - % dry weight, parts per million (ppm), $\mu\text{g g}^{-1}$, mmol kg^{-1} , $\text{mg } 100\text{g}^{-1}$, mg kg^{-1} , mg L^{-1} , g kg^{-1}

Analysis

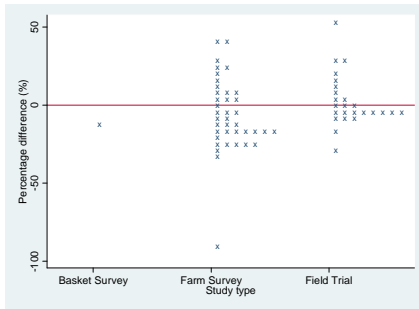
- Insufficient data for individual foods – apple
- Consolidated into nutrient groups – vitamin C
- Analysis on groups reported in ≥ 10 studies
- Metric = % standardised difference
- t-tests with robust standard errors (to account for clustering caused by multiple nutrient comparisons within studies)

Results

Overall findings

- No evidence of difference in crops for
 - Vitamin C
 - Phenolic compounds
 - Magnesium
 - Calcium
 - Potassium
 - Zinc
 - Soluble solids
 - Copper

Vitamin C

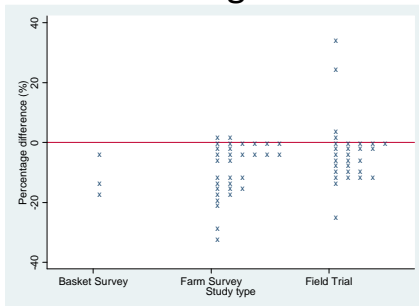


n			
Studies	Comparisons	% difference	p-value
14	65	-2.7 ± 5.9	0.84

But...

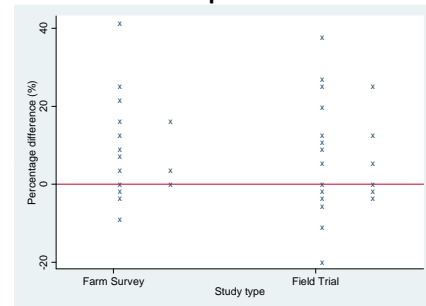
- Nitrogen content higher in conventional crops
- Phosphorus content and acidity higher in organic crops

Nitrogen



n			
Studies	Comparisons	% difference	p-value
17	64	-6.7 ± 1.9	0.003

Phosphorus



n			
Studies	Comparisons	% difference	p-value
12	35	8.1 ± 2.6	0.009

Are these differences relevant to public health?

Nitrogen

- present in all foods; not a critical factor in our diet

Phosphorus

- present in animal source foods and whole grain cereals; not a critical factor in our diet

Acidity

- a matter of taste not health

Overall conclusion

- no evidence of important differences in nutrient content

Systematic review 2: Health Benefits

- Pre-specified protocol
- Pre-specified question
 - “Is there a nutrition-related health benefit from consuming organic food?”
- Human, *in vivo* and animal studies
- Search strategy found 92,000+ papers
- Screening identified 11 relevant studies

Strength of evidence

- Significant shortcomings in study designs
 - 7 failed to define “organic”
 - questionable designs
 - self reported exposures and outcomes
 - inappropriate statistical analysis
- Significant shortcomings in reporting
- Currently no evidence of nutrition-related health benefits of consuming organic foods

Organic food—eat the emotion, but question the evidence

Last week, the UK's Food Standards Agency (FSA) studies were so heterogeneous (one of their graphics

Those who have criticised the review perhaps do not know enough about what a systematic review is. Because the review set out to look at nutrient content only, it is wrong to point out that it did not include analysis of pesticides, herbicides, or fungicides. Nor did the review attempt to look at taste and freshness, food miles, animal welfare, biodiversity, or sustainability.

of a satisfactory quality. The reviewers found that the residues, and is kinder to farmed animals. ■ The Lancet

428 www.thelancet.com Vol 374 August 8, 2009

Conclusions

- Our reviews are systematic, comprehensive, independent and fully peer-reviewed
- There is currently no evidence of important differences in nutrient content and no evidence of nutrition-related health benefits
- Our reviews highlight shortcomings in both the quality of research and its reporting