



**Content, Bioavailability and Health Effects  
of Trace Elements and Bioactive  
Components of Plant Food Products  
Cultivated in Organic Agricultural Systems**

**OrgTrace**



Søren Husted  
Department of Agriculture and Ecology  
Plant and Soil Science Laboratory  
University of Copenhagen



# Er økologiske planteprodukter sundere ?



**"Økologiske fødevarer er sundere. De indeholder flere af de gode**

**stoffer som mineraler og planternes immunstoffer. Og de indeholder mindre af det dårlige som pesticidrester, nitrat og tilsætningsstoffer."**

- PER BRÆNDGAARD MIKKELSEN, ERNÆRINGSEKSPERT OG CAND. SCIENT I HUMAN ERNÆRING/KENDT FRA TV ?



# State-of-the-art: "The Popular Media"



# State-of-the-art: The Scientific

Journal of the Science of Food and Agriculture

## Effect of plant cultivation methods on content of major and trace elements in foodstuffs and retention in rats

Mette Kristensen,<sup>1</sup> Lars F Østergaard,<sup>2</sup> Ulrich Halekoh,<sup>3</sup> Henry Jørgensen,<sup>4</sup> Charlotte Lauridsen,<sup>4</sup> Kirsten Brandt<sup>5</sup> and Susanne Bügel<sup>1\*</sup>

<sup>1</sup>Department of Human Nutrition, University of Copenhagen, Rolighedsvej 30, DK-1958 Frederiksberg C, Denmark  
<sup>2</sup>The Danish Plant Directorate, Skovbrynet 20, DK-2800 Lyngby, Denmark  
<sup>3</sup>Department of Genetics and Biotechnology, University of Aarhus, Research Centre Foulum, PO Box 50, DK-8830 Tjele, Denmark  
<sup>4</sup>Department of Animal Health, Welfare and Nutrition, University of Aarhus, Research Centre Foulum, PO Box 50, DK-8830 Tjele, Denmark  
<sup>5</sup>School of Agriculture, Food and Rural Development, Newcastle University, Agriculture Building, Newcastle upon Tyne NE1 7RU, UK

### Abstract

**BACKGROUND:** Many consumers perceive organic foods as more nutritious than conventional foods. However, the existing evidence is insufficient to support or refute this belief. The purpose of the present study was to investigate the effect of three different model cultivation systems on selected major and trace element contents of dried foodstuffs (carrots, kale, peas, potatoes and apples) grown in two consecutive years, as well as mineral retention determined in 36 rats (second generation in a multi-generation study) fed diets based on these foodstuffs.

**RESULTS:** Overall, there was no evident trend towards differences in element content of foodstuffs or diets due to the use of different cultivation systems, and differences between harvest years exceeded those seen between cultivation methods. Also, no significant differences in the retention of elements in rats fed diets derived from different cultivation systems were seen, since higher intake resulted in correspondingly higher excretion.

**CONCLUSION:** This study does not support the belief that organically grown foodstuffs generally contain more major and trace elements than conventionally grown foodstuffs, nor does there appear to be an effect on the bioavailability of major and trace minerals in rats.

© 2008 Society of Chemical Industry

Journal of the Science of Food and Agriculture

## Review Quality of agriculture

Ewa Rembiałko  
Organic Foodstuffs Div  
PL-02 776 Warszawa.

Abstract: During growing ecological crops started to local environmental crops contain fewer nitrate compounds, essential amino acids, more mineral compounds and usually

The objectives of the present study were to: (i) identify agronomic parameters that affect the safety; (ii) carry out a pilot study to determine hormonal balances and immune status in a production system; (iii) identify agronomic parameters that affect the safety; (iv) carry out a pilot study to determine hormonal balances and immune status in a production system.

The results showed that organic food production methods contain more nutritionally desirable compounds (e.g., vitamins/minerals, fatty acids such as omega-3 and CLA); (b) lower levels of compounds such as heavy metals, mycotoxins, pesticide residues.

Journal of the Science of Food and Agriculture 87:2757-2762 (2007)

Journal of the Science of Food and Agriculture 88:2161-2172 (2008)



of  
en  
ave  
and  
ower  
ganic  
cnologic  
stically  
are also



Comparison of ...

## A literature-based comparison of nutrient and contaminant contents between organic and conventional vegetables and potatoes

Christine Hoefkens, Isabelle Vandekinderen, Bruno De Meulenaer, Frank Devlieghere, Katleen Baert, Isabelle Sioen, Stefaan De Henauw, Wim Verbeke, John Camp

Other  
reduced  
temperature

it

In c  
the  
fr  
n  
c  
s

## The nutritional and toxicological value of organic vegetables: Consumer perception versus scientific evidence

Christine Hoefkens, Wim Verbeke, Joris Aertsens, Koen Mondelaers, John Van Camp

British Food Journal, 2009, 111, 1062-1077

### Abstract

...It was found that organic vegetables are perceived as containing less contaminants and more nutrients, and as such, being healthier and safer compared to conventional vegetables. However, **not enough evidence is currently available in the literature** to support or refute such a perception, indicating a certain mismatch between consumer perception and scientific evidence.....

and con...

Contract  
PAU221

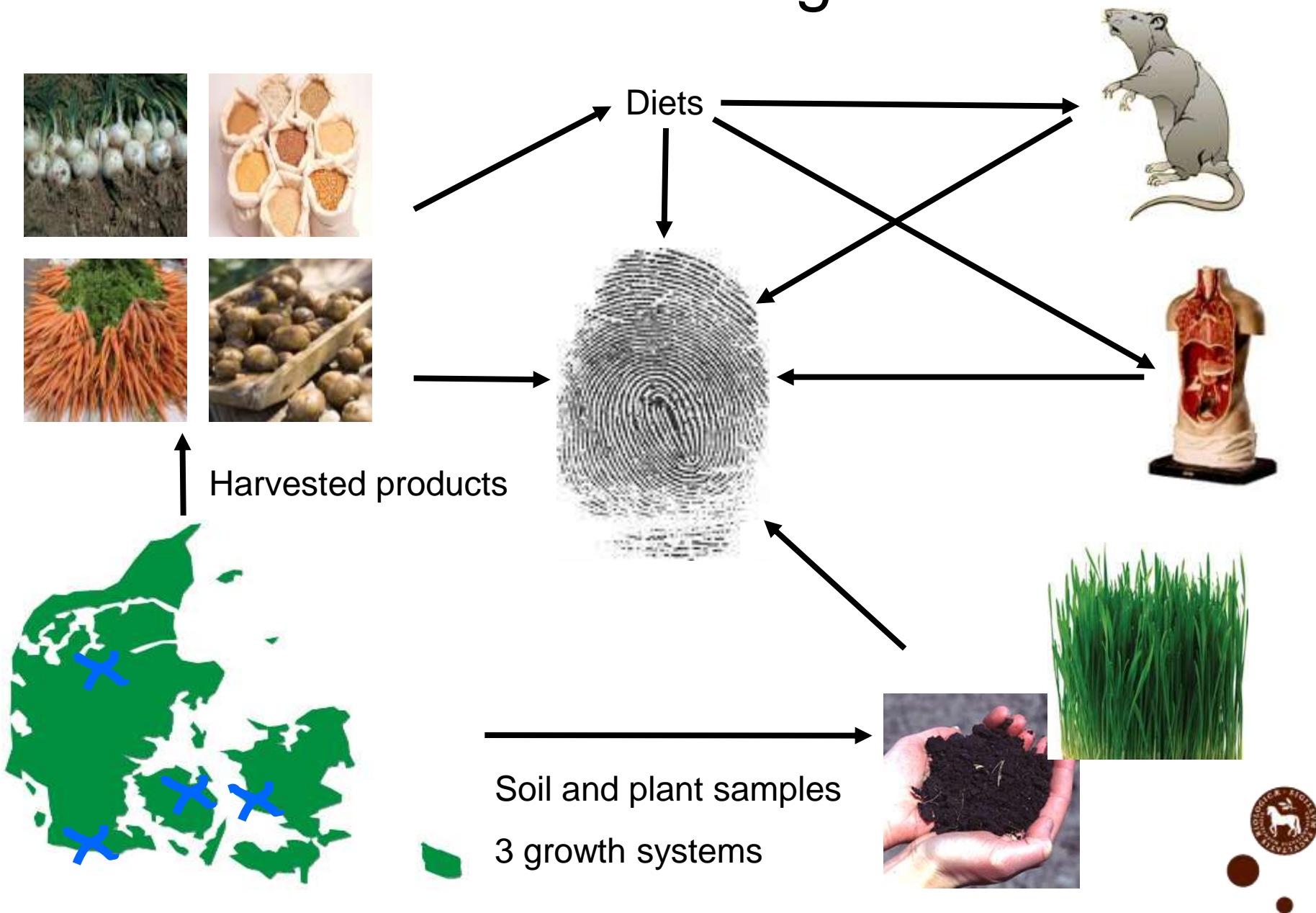
Submission  
July 2010



# No wonder that consumers are confused.....



# Work flow in OrgTrace



# OrgTrace Work Packages

WP1: Multi-elemental classification analysis, nutrients/anti-nutrients

WP2: Identification of bioactive Se and S metabolites

WP3: Analysis of vitamins, carotenoids, polyactylenes, flavonoids, proanthocyanidins

WP4: Health status and well-being in animal model

WP5: Human bioavailability, minerals & phytochemicals

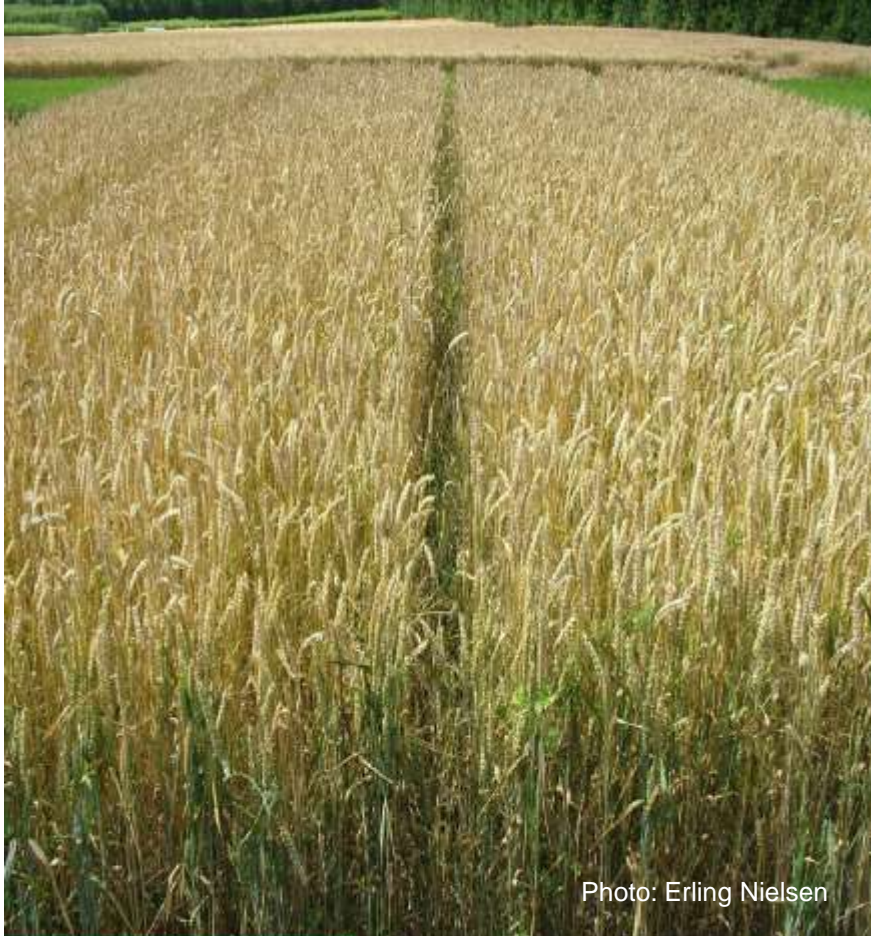


# Growth systems

Agricultural system	CropSys abbreviation	VegQure abbreviation	Notes
Organic A	O4; -CC/+M	O1; slurry	Slurry application
Organic B	O4; +CC/-M	O2; green manure	Green manure and catch crops
Conventional with NPK fertilizer and pesticide application	C4; -CC/+M	C1; NPK	Inorganic fertilizers



# Conventional and organic wheat



# % nitrogen per gram tørstof i 2007 og 2008 (alle lokaliteter)

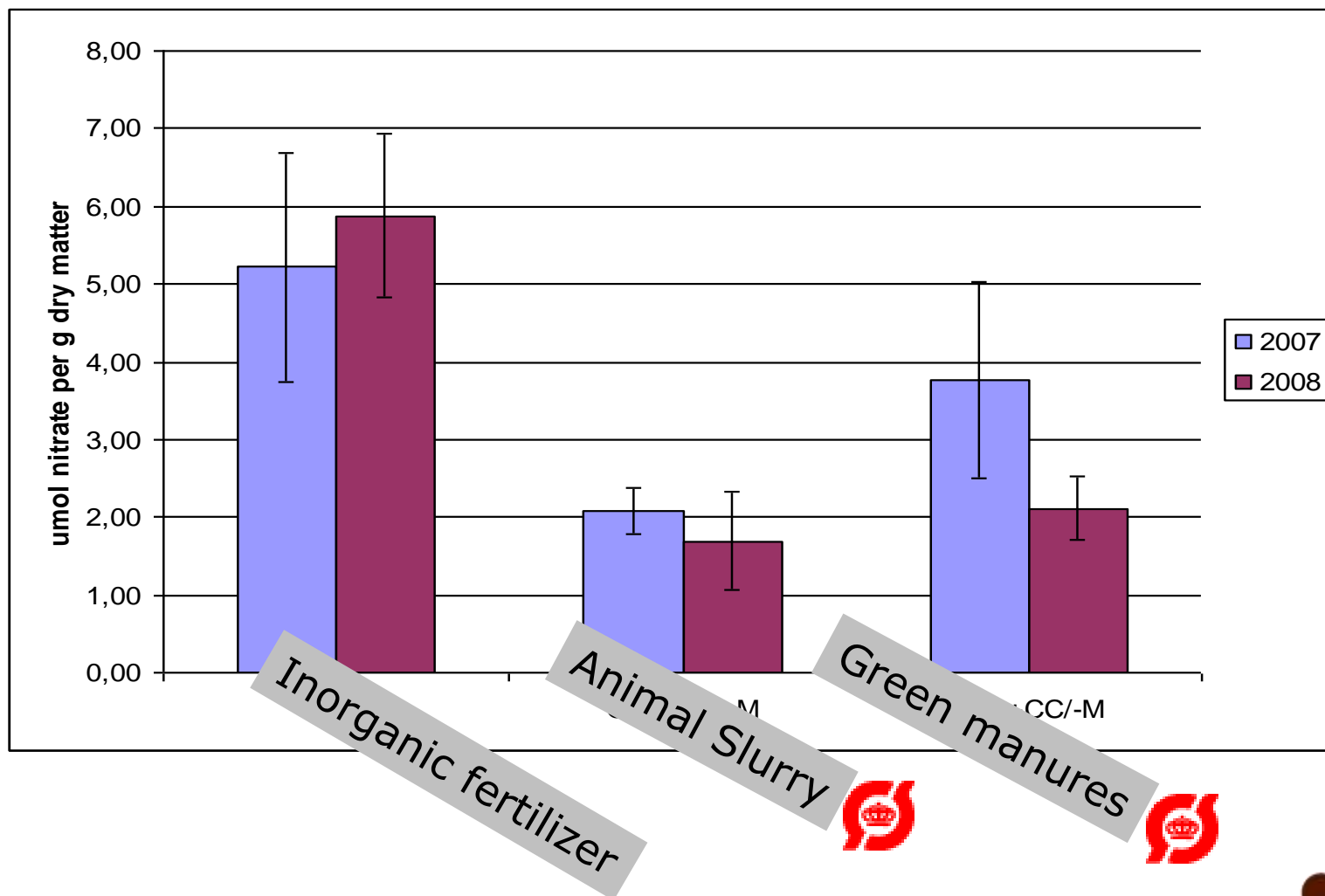
	Kg N tilførsel ha <sup>-1</sup> (Konv/Økologi A/B)	Konventionel (NPK)	Økologi A (Gylle)	Økologi B
Faba bønne	0/0	5,1 ± 0,3	5,0 ± 0,1	5,2 ± 0,3
Hvede	165/110	2,0 ± 0,2	1,5 ± 0,1	1,5 ± 0,1
Byg	130/60	1,7 ± 0,3	1,3 ± 0,1	1,4 ± 0,1
Havre	90/50	2,2 ± 0,2	1,8 ± 0,1	1,8 ± 0,1
Raps	189/110	3,3 ± 0,5	2,9 ± 0,3	2,8 ± 0,3
Kartoffel	140/110	1,5 ± 0,2	1,7 ± 0,2	1,5 ± 0,1
Hvidkål	309/250/150	1,9 ± 0,1	1,8 ± 0,2	1,9 ± 0,2
Gulerod	120/60	0,9 ± 0,1	0,7 ± 0,1	0,8 ± 0,0
Løg	170/120/75	1,5 ± 0,2	1,3 ± 0,2	1,4 ± 0,1

**Ingen signifikante forskelle i tørstofindhold**



# Nitrate in carrots

- organic and conventional on same soil in two consecutive years.



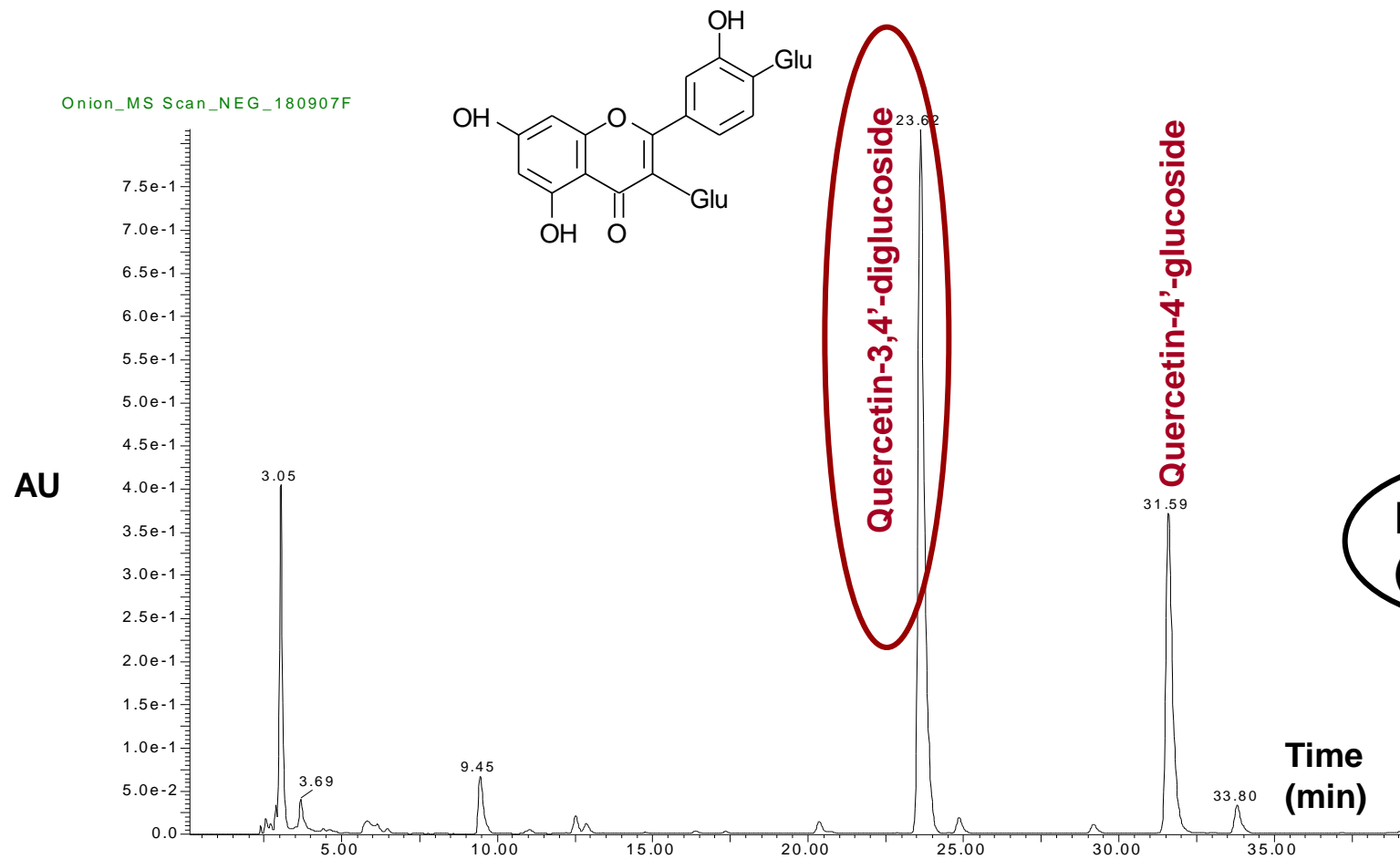
# Zn concentrations all locations ( $\mu\text{g g}^{-1}$ DM)

	System 1	System 2	System 3
<b>Faba bean</b>	42 $\pm$ 1	48 $\pm$ 1	43 $\pm$ 5
<b>Wheat</b>	19 $\pm$ 0.5	19 $\pm$ 1	19 $\pm$ 1
<b>Barley</b>	22 $\pm$ 1	22 $\pm$ 0.5	21 $\pm$ 1
<b>Oat</b>	23 $\pm$ 2	22 $\pm$ 1	22 $\pm$ 1
<b>Rape seed</b>	39 $\pm$ 0.5	31 $\pm$ 1	30 $\pm$ 1
<b>Potato</b>	11 $\pm$ 0.5	12 $\pm$ 0.5	11 $\pm$ 0.5
<b>Cabbage</b>	13 $\pm$ 1	12 $\pm$ 1	13 $\pm$ 0.5
<b>Carrot</b>	9 $\pm$ 1	8 $\pm$ 0.5	10 $\pm$ 4
<b>Onion</b>	12 $\pm$ 3	12 $\pm$ 1	12 $\pm$ 1



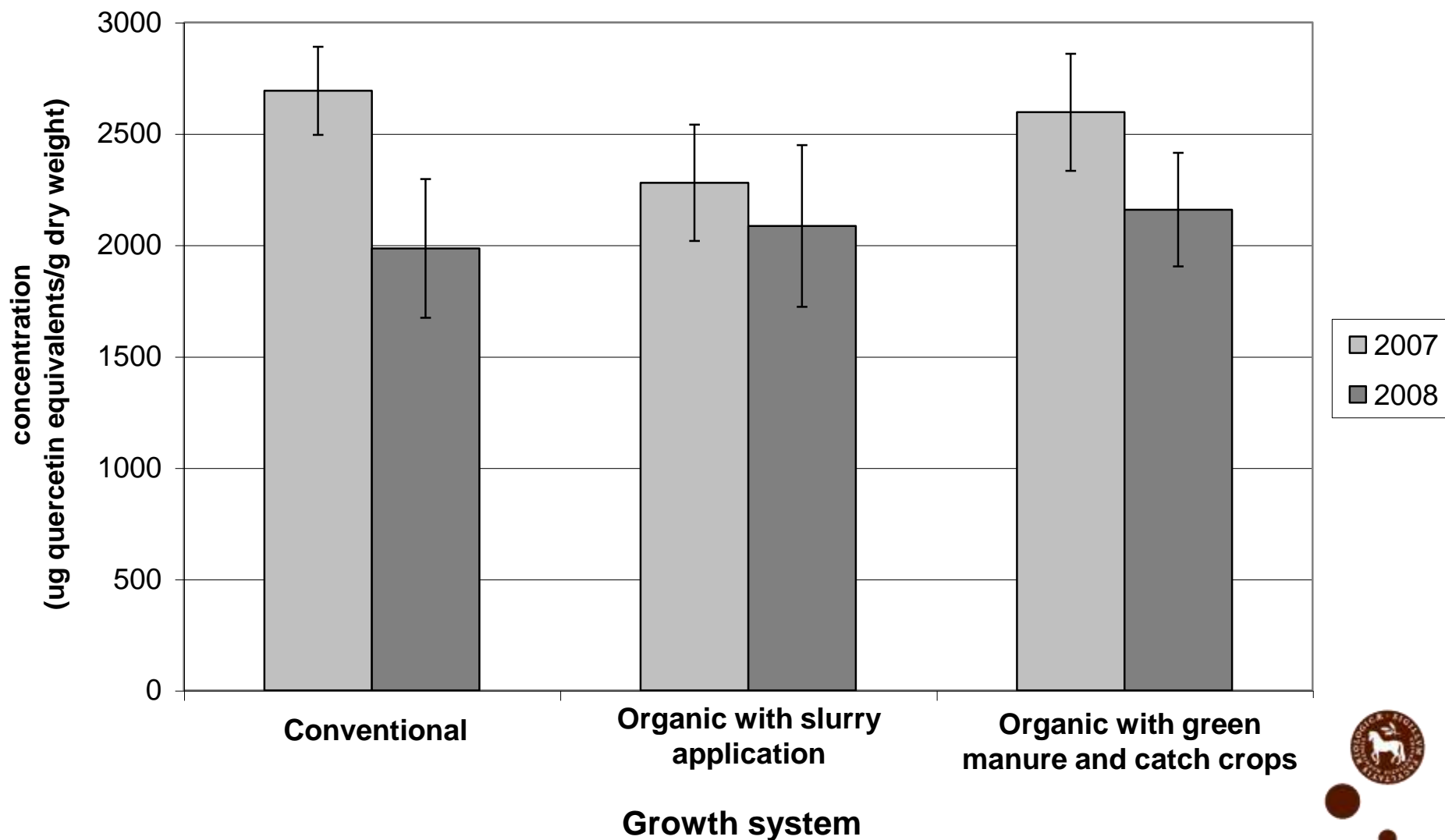


# Flavonoids – Onions



# Flavonoids – Quantitative analysis

## Quercetin-3,4'-diglucoside



# Plasma status of main carotenoids at end time

Year	Carotenoid	Growth system		
		C	OA	OB
1	Lutein	0.23 ± 0.09 <sup>A</sup>	0.19 ± 0.09 <sup>B</sup>	0.19 ± 0.07 <sup>B</sup>
1	α-carotene	0.26 ± 0.09	0.23 ± 0.09	0.26 ± 0.08
1	β-carotene <sup>a</sup>	0.69 ± 0.29 <sup>A</sup>	0.49 ± 0.22 <sup>B</sup>	0.55 ± 0.20 <sup>B</sup>
		0.40 ± 0.09 <sup>C</sup>		
2	Lutein	0.18 ± 0.05 <sup>A</sup>	0.16 ± 0.05 <sup>C</sup>	0.17 ± 0.05 <sup>B</sup>
2	α-carotene	0.26 ± 0.09	0.26 ± 0.07	0.26 ± 0.09
2	β-carotene	0.62 ± 0.38	0.65 ± 0.38	0.63 ± 0.40

Values with different superscripts within the same row are significantly different at P<0.05

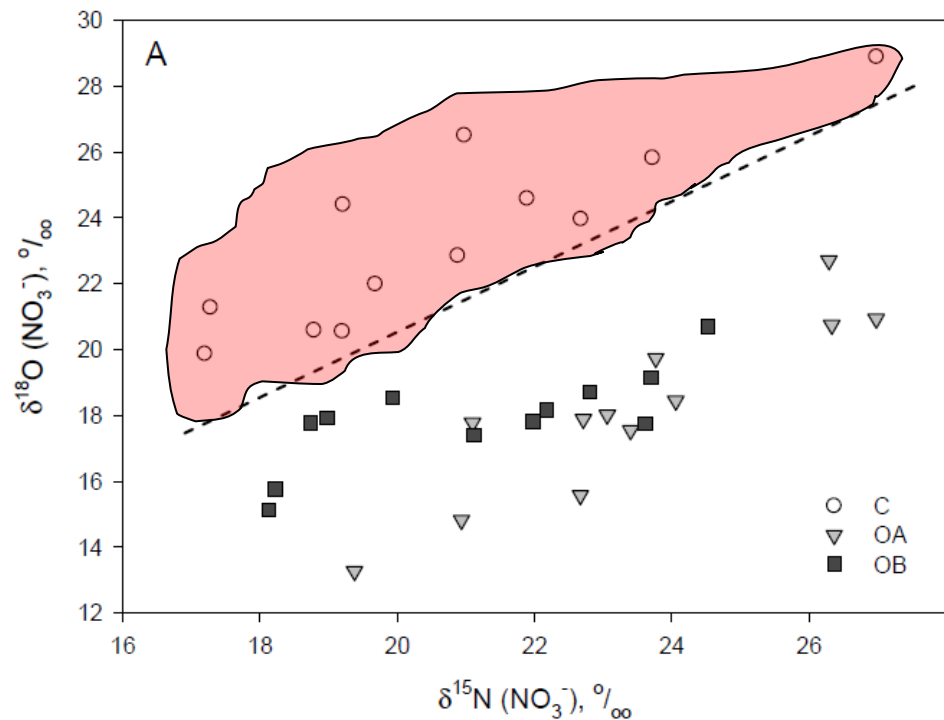


# Conclusions

- No difference in content between systems for selected minerals and metabolites
- Nitrate differ between systems
- No difference in absorption/retention of any mineral and bioactive component
- However, an organic fingerprint exist which is unique to a cultivation system without inorganic fertilizers



# Isotope fractionation in plants depending on nutrition



# Acknowledgements

- **KU-LIFE:**
- Søren Husted
- Alicja Budek
- Susanne Bugel

- **DTU-FOOD:**
- Emese Kapolna
- Malene Søltøft
- Pia Knuthsen
- Erik Huusfeldt Larsen



- **AAU-AgriSci:**
- Charlotte Lauridse
- Maja Jacobsen
- Henry Jørgensen
- Kristian Kristensen
- Ulrich Halekoh
- Helle Madsen



# The Organic Isotopic Fingerprint

