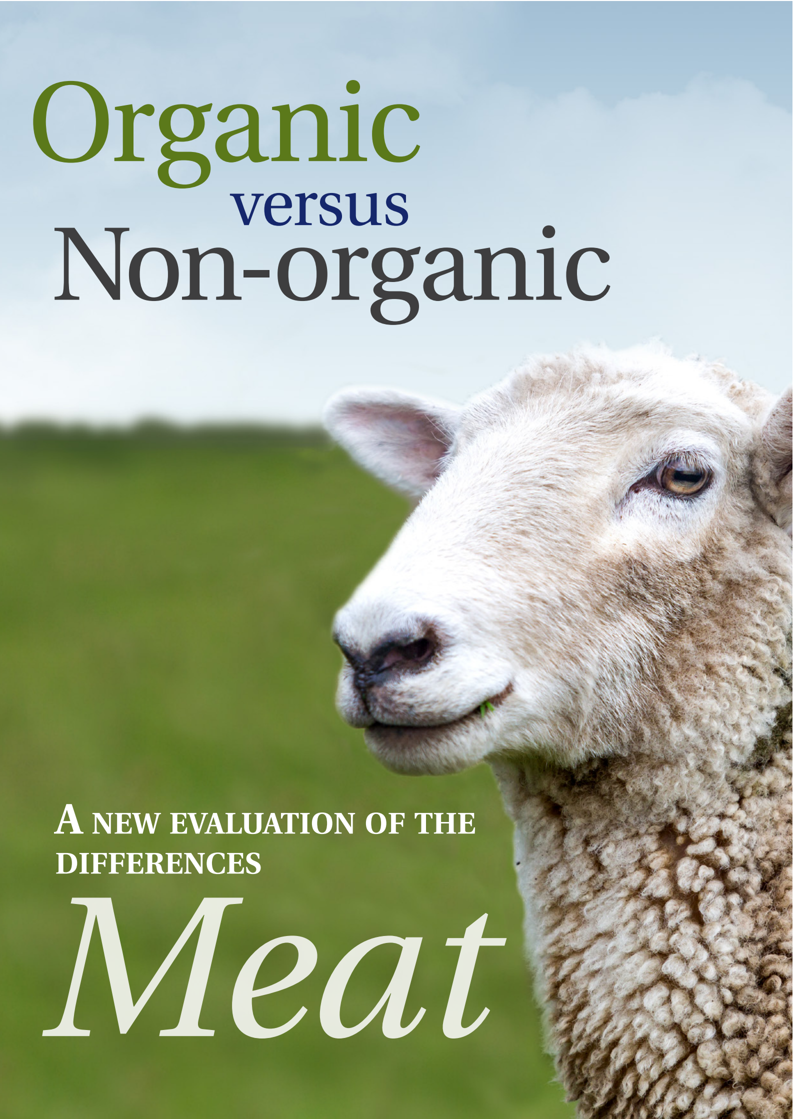
Organic versus Non-organic

A new evaluation of the differences

Meat



“Switching to grass-fed organic meat consumption may allow meat consumption to be reduced by 30% whilst maintaining total omega-3 fatty acid intake”

Contents

February 2016

New evidence

A landmark paper in the "*British Journal of Nutrition*" concludes that organically produced meat contains significantly higher concentrations of nutritionally desirable, polyunsaturated and omega-3 fatty acids, and lower levels of two undesirable saturated fatty acids (myristic acid and palmitic acid).

Nutritional benefits
The Newcastle University-led international study is the most up-to-date analysis of published research into the nutrient content of organic compared to conventionally produced foods, synthesising the results of many more studies than previous analysis. The results of this meta-analysis showed that organic meats (especially beef) were of higher nutritional quality than their non-organic counterparts.

Limitations
The peer-reviewed scientific study is the **first extensive analysis** of the nutritional content of organic and non-organic meat ever undertaken. However, compared to crops and milk/dairy products there is less published information for meat. This results in substantial limitations which include:

- for the majority of nutrients, data for beef, lamb, goat, pork and poultry had to be combined, since there was insufficient data to compare within each meat type
- for many nutritionally relevant compounds (e.g. minerals, vitamins, antioxidants toxic metals, pesticides) it was not possible to analyse differences accurately, and
- there was a lack of data for very extensive, pasture-based organic meat (especially pork and poultry) production systems.

At a glance – organic vs non-organic

- **Production method affects quality:** this new analysis is the most extensive and reliable to date and supports the view that the nutritional quality of meat is influenced by the way it is produced. Controlled feeding studies with beef, lamb and pigs support the view that the outdoor grazing/foraging based diets prescribed by organic farming standards, were responsible for the more desirable fat composition in organic compared to conventional meat.*

- **More of the good, less of the bad:** organic meat has more desirable poly-unsaturated and omega-3 fatty acids and less myristic and palmitic acid, which are potentially harmful saturated fatty acids. Trends towards higher iron (Fe) levels, and lower concentrations of copper (Cu) and the toxic metal cadmium (Cd) in organic meat need to be confirmed in future studies.*

- **Health benefits:** meat is a substantial source of omega-3 fatty acids – of scientific interest due to strong evidence for beneficial effects on human health, including potential protection against cardiovascular diseases, certain cancers and dementia. Myristic acid is the saturated fatty acid most clearly linked to increased cardiovascular disease risk.*

- **Organic IS different:** the new study clearly shows that there are meaningful nutritional differences between organic and non-organic foods.

*See page 20 for more information.

Why is this study different?

The Newcastle University-led study "*Composition differences between organic and conventional meat*" is the first systematic comparison of organic and conventional meat, and part of the most comprehensive scientific review of the organic versus non-organic debate so far. Other studies focused on crops (Baranski *et al*. 2014) and milk/dairy products (Srednicka-Tober *et al*. 2016).

Its conclusions contrast markedly with other widely cited studies of the past decade in finding significant differences in the nutritional composition of organic versus non-organic food, and there are several likely reasons for this.

More recent data

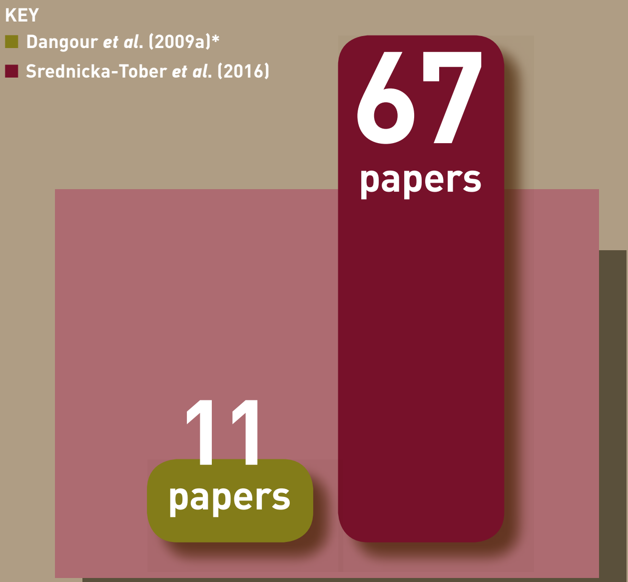
It is the first analysis to extensively review the results of all 67 studies available for meat in the past few years. Approximately two thirds of those analysed have been published after 2006 and therefore were not included in the UK Food Standard Agency (FSA) sponsored study (Dangour *et al*. 2009a) (Figure 1).

More reliable methodology

The statistical methods used in the Newcastle University-led study were an advance over the previous research synthesis that did not balance the contribution of larger versus smaller studies. The earlier synthesis (Dangour *et al*. 2009a) also used less reliable inclusion criteria and combined data from meat and milk.

Interestingly, Dangour *et al*. reported a trend towards significantly higher levels of polyunsaturated and omega-3 fatty acids in organic livestock products (meat and milk) in their report to the FSA (Dangour *et al*. 2009b), but not in the paper and press release they published.

Figure 1. Numbers of published papers used in meta-analysis of composition differences in meat



* In the FSA sponsored study by Dangour *et al.* (2009a) data from 11 papers on meat were combined with data from 12 papers on milk and analysed together and reported as composition

Key findings

The Newcastle University-led study is based on a systematic review and analysis of data from 67 meat-focused papers using state-of-the-art meta-analysis methods. This involves combining and then carrying out a statistical analysis of all available published results, to provide much more comprehensive estimates for composition differences than any single trial can.

The aim of this overarching study was to identify and quantify compositional differences between organic and conventional meat that might be relevant to human health.

The analysis presents substantial evidence that switching to meat produced to organic standards will lead to elevated intake of nutritionally desirable omega-3 fatty acids and reduced intake of potentially harmful saturated fatty acids (myristic acid and palmitic acid).

It also identified trends towards higher iron (Fe), but lower copper (Cu) and cadmium (a toxic 'heavy' metal) levels in organic meat, although further studies are required to confirm these results.

"The quality of meat is directly influenced by livestock husbandry and feeding regimes"

Fatty acid composition

Organic meat had a more desirable fat composition with higher concentrations of nutritionally desirable poly-unsaturated fatty acids (23% higher) and omega-3 fatty acids (47% higher), but significantly less undesirable saturated fatty acids myristic acid (18% lower) and palmitic acid (11%).

Meat is a major source for omega-3 fatty acids in our diet, especially for individuals eating little or no fish. There are UK and European recommendations (Food Standards Agency and European Food Safety Authority) to increase our intake of omega-3 fatty acids.

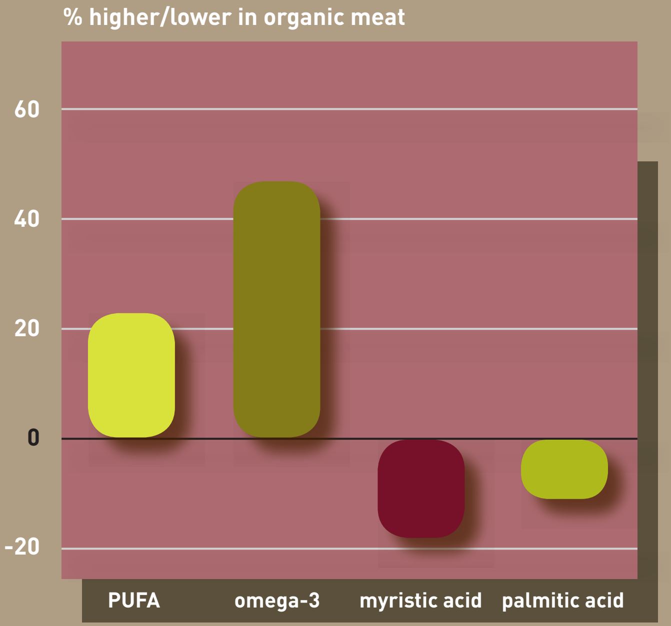
A switch to consuming organic meat would allow either:

- a significant (30%) reduction in meat consumption (in line with current dietary recommendations) whilst maintaining our omega-3 fatty acid intake

or

- a 50% increase in meat-based omega-3 fatty intakes for the same meat consumption

Figure 2. Differences in fatty acid composition between organic and conventional meat



Organic farming standards

Organic livestock standards are strictly regulated in the European Union, the USA and many other countries. Any food labelled 'organic', 'biological' or 'ecological' must legally meet these standards and is regularly inspected by organic certification bodies. Organic standards prescribe that:

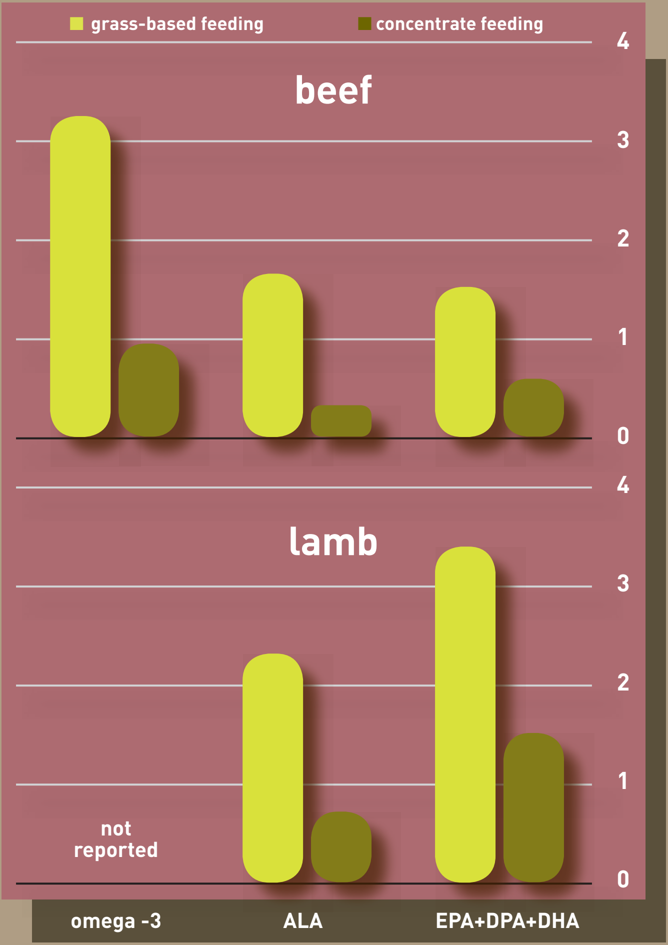
- livestock are reared outdoors at least for part of the year, although the length of outdoor periods differs between regions and species
- at least 60% of ruminants (cattle, sheep, goats) diets are fresh or conserved forages (hay, silage), and that fresh forages are from outdoor grazing "whenever conditions allow"
- non-ruminants (pigs, poultry) diets also have to include forages, although this can be solely conserved forages

In many regions of Europe there are substantial differences in the way organic and conventional livestock are fed and managed. In many conventional production systems there has been a trend towards **(a)** longer periods or all year round housing indoors, **(b)** reduced access to grazing, but **(c)** more conserved forage and/or concentrate feed made from cereals, grain legumes and by-products being fed.

How do organic standards affect meat quality?

Controlled experimental studies have suggest that differences in fatty acid profiles between organic and conventional meat are primarily driven by differences in feeding regimes . Studies comparing meat quality from forage based diets (typical for organic and grass-fed systems) to that from grain based feeding (typical for intensive conventional systems) show forage diets result in higher levels of PUFA and omega-3 fatty acids and lower levels of myristic and palmitic acid in beef and lamb (Nuernberg *et al*. 2005; Fisher *et al*. 2000). Although this impact of forage on omega-3 fatty acids is particularly strong in beef and lamb (Figure 3), a similar trend was also found when meat from free-range pigs with access to pasture was compared to meat from indoor reared pigs (Nilzén *et al*. 2001).

Figure 3. Effect of cattle and sheep diets (grass-fed and grain-fed) on total omega-3, ALA and very long chain fatty acid concentrations in beef and lamb (based on data from Nuernberg *et al*. 2005; Fisher *et al*. 2000)


grass-based feeding
concentrate feeding
beef
lamb
4
3
2
1
0
4
3
2
1
0
not reported
omega -3
ALA
EPA+DPA+DHA

Can the nutritional quality of organic meat be improved further?

Research has identified diets based on **(a)** long periods grazing outdoors, **(b)** high forage and (c) low concentrate intakes as the main reasons for the higher omega-3 and lower myristic and palmitic acid levels in organic meat.

Increasing access to pasture, total forage intake and further reducing concentrate supplementation is therefore likely to further improve the nutritional quality of meat. A recent US study comparing organic beef from **(a)** purely grass-fed and **(b)** grass + concentrate-fed cattle found that purely grass-fed cattle produced beef had :

- more than twice the omega-3,
- less than half the omega-6 and
- around 20% lower myristic and palmitic acid

concentrations than that from grazing cattle also receiving concentrate, although it should be pointed out that supplementation levels were close to the maximum permitted under USDA organic standards (Bjorklund *et al*. 2014).

Breed selection for meat quality and breeding strategies may also further improve the nutritional quality of organic meat (Fisher *et al*. 2000; Nilzen *et al*. 2001; Nuernberg *et al*. 2005).

Can non-organic, "grass-fed" systems deliver similar high quality meat?

Although overall, conventional meat production has become more intensive, a substantial proportion of beef, but especially lamb and goat meat, still comes from traditional, grazing-based production systems in both Europe and North America.

Pasture-based and "grass-fed" production systems have been shown to produce beef, lamb and goat meat with very similar fatty acid and antioxidant profiles to organic systems using similar feeding regimes and breeds (see for example the review paper by Daley *et al*. 2010).

However, organic farming standards also prohibit or restrict the use of antibiotics, insecticides, hormone and other veterinary treatments, while these can be used in non-organic grass-fed systems. The risk of residues from these veterinary treatments being present in meat is therefore thought to be higher than in meat from organic grass-fed systems.

What are saturated, unsaturated and omega-3 fatty acids?

The fat in our foods and body is composed of a mixture of a wide range of fatty acids. Dietary fats are "broken down" into fatty acids, which are then taken up and used for energy generation, building blocks in our cell walls and/or fat storage.

Fatty acids are chains of carbon atoms defined by **(a)** the length (number of carbon atoms) of the carbon chain and **(b)** the number and position of double bonds in the carbon chains. A saturated fatty acid (SFA) has no double bonds, a monounsaturated fatty acid (MUFA) has one double bond and a polyunsaturated fatty acid (PUFA) two or more double bonds.

All fatty acids account for the same amount of energy (9kcal/g), and if we take up more fat than the body needs for "burning" as energy or as cell wall building blocks, excess will be stored as body fat. Too much of any fat can therefore contribute to weight gain, but there are major differences in the impacts of saturated, mono-unsaturated and poly-unsaturated fatty acids on the risk of a range of chronic diseases.

Saturated fatty acids

High consumption of saturated fatty acids (particularly stearic, myristic and palmitic acid) is associated with increased blood cholesterol and insulin resistance, which contribute to cardiovascular disease and type 2 diabetes risk (Hu *et al.*, 2001).

Dietary sources of saturated fats include dairy products, meat and certain vegetable oils (e.g. palm oil).

Unsaturated Fatty acids

Both MUFA and PUFA contribute to reductions in blood cholesterol levels and a range of PUFA are associated with reduced risk of cardiovascular disease (Hu *et al.*, 2001).

Major dietary sources of unsaturated fats are vegetable oils which may contain high levels of MUFA (e.g. olive oil, avocado and peanut oil) or PUFA (e.g. sunflower, sesame and flax or linseed oil).

Omega-3 and omega-6 fatty acids

The human body can make all of the fatty acids it needs ***except*** for two specific polyunsaturated fatty acids both with 18 carbon atoms in their chains (EFSA, 2010):

- alpha (α)-linoleic acid (ALA), an omega-3 (*n*-3) fatty acid, and
- linoleic acid (LA), an omega-6 (*n*-6) fatty acid

Since the body cannot generate ALA and LA these two fatty acids are considered essential and have to be taken up with the diet. ALA and LA are found in both animal fat and vegetable oils, but concentrations and ALA:LA ratios differ considerably.

The human body can convert ALA into longer chain omega-3 fatty acids (with 20 or more carbon atoms). These very long chain (VLC) omega-3 fatty acids are particularly important for human health and include **(a)** eicosapentaenoic acid (EPA), **(b)** docosapentaenoic acid (DPA), and **(c)** docosahexaenoic acid (DHA). Since the conversion of ALA to VLC-omega-3 fatty acids in the human body is relatively inefficient, we rely on taking sufficient amounts of EPA, DPA and DHA in our diet.

Important dietary sources for EPA, DPA and DHA are fish (especially oily fish), meat and dairy fat and seaweed, while vegetable oils contain virtually no VLC omega-3 fatty acids.

For further information on fat and fatty acids see WHO (2008) and EFSA (2010)

What does this mean for the consumer?

By presenting evidence that choosing food produced using organic standards can lead to better nutrition, the new findings make an important contribution to the information currently available to consumers.

Higher concentrations of polyunsaturated and omega-3 fatty acids

A range of poly-unsaturated fatty acids (PUFA) have been linked in scientific studies to a reduced risk of cardiovascular disease. This includes **(a)** linoleic acid (LA, the main omega-6 fatty acid found in meat), **(b)** α-linoleic acid (ALA, the main omega-3 fatty acid found in milk) and the very long chain (VLC) omega-3 fatty acids **(c)** eicosapentaenoic acid (EPA), **(d)** docosapentaenoic acid (DPA), and **(e)** docosahexaenoic acid (DHA).

EPA, DPA and DHA have also been linked to other health benefits improved foetal brain development, delayed decline in cognitive function in elderly men, and reduced risk of dementia (especially Alzheimer's disease).

The European Food Safety Authority (EFSA) estimates that average dietary intakes of VLC omega-3 fatty acids account for less than half of what we need for optimum health. To reduce cardiovascular disease risk, European and North American agencies therefore currently advise consumers to increase fish and especially oily fish consumption to increase their VLC omega-3 intake. Unfortunately implementing these recommendations widely across the human population is impossible, since most of the world's fish stocks are already fully or overexploited.

Lower concentrations of myristic and palmitic acid

Saturated fatty acids in meat fat such as myristic acid and palmitic acid are widely considered to have a negative effect on human health, since they have been linked to a higher risk of cardiovascular disease (Hu *et al*. 2001).

For most European and North American consumers, meat supplies approximately half of the recommended adequate VLC omega-3 fatty acid intake, but also a substantial proportion of the saturated fat intake. A switch to organic meat, at the same total consumption, is estimated to raise our intake of "healthy" omega-3 fatty acid by 50% while reducing unhealthy saturated fat consumption.

Into the future...

This latest analysis is the most extensive and reliable carried out so far comparing the nutrient content in organic and conventionally produced meat and provides clear evidence of significant compositional differences.

The big unknown remains the agrochemical residue burden in conventional meat and milk – whether that is toxic metals such as cadmium from mineral P-fertilisers, pesticide in feeds, growth hormones which are widely used in North America, or antibiotics and other veterinary treatments used excessively in conventional animal production.

Further research needed

Future research is required to allow compositional differences for individual meat types (beef, sheep, goat, poultry, rabbit) to be quantified accurately. There is also a need to assess a much wider range of **(a)** undesirable compounds (pesticides, growth hormones, antibiotics and other veterinary treatments, and toxic metals such as cadmium) and **(b)** nutrients for which meat is an important dietary source including minerals (e.g. Fe, Zn, Se, Cu), vitamins (e.g. vitamin A, vitamin B1, B6, B12, riboflavin, folate, niacin, pantothenic acid) in future studies.

There have now been several studies linking the extensive use of antibiotics in conventional livestock production to a higher risk of antibiotic resistant strains of bacterial pathogens such as *Salmonella* and *E. coli* being present in livestock (Hoyle *et al*. 2004; Leifert *et al*. 2008). Further research is needed to confirm these results and investigate potential health impacts.

It is also important to gain a better understanding of the relative impact of grazing, feeding, breed choice and other aspects of management on the composition of meat.

There is limited evidence on the effects of eating organic food on human health. However, two relatively new scientific human cohort studies have found that eating organic vegetables or dairy products was associated with positive health impacts including a 58% reduced risk of genital deformation in boys (Brantsæter *et al*. 2015) and a 21% lower risk of pre-eclampsia during pregnancy (Torjusen *et al*. 2014). An earlier study showed that organic milk consumption reduced the risk of eczema in children under 2 years of age by 36% (Kummerling *et al*. 2008).

This and the findings of this study clearly demonstrate the urgent need for further research to identify and quantify health impacts of switching to organic meat consumption.

Finding out more

To read the full paper, as published in the *British Journal of Nutrition,* go to: http://research.ncl.ac.uk/nefg/QOF

This includes further information, annexes and summary information in Chinese, English, French, German, Italian, Polish, Portuguese, Spanish, Russian and a range of other languages.

Srednicka-Tober D. *et al.* (2016) Composition differences between organic and conventional meat; a systematic literature review and meta-analysis. British Journal of Nutrition February 2016

The authors of this latest study welcome continued public and scientific debate on this important subject.

The entire database generated and used for this analysis is freely available on the Newcastle University website (http://research.ncl.ac.uk/nefg/QOF) for the benefit of other experts and interested members of the public.

Links

www.nealsyardremedies.com
www.soilassociation.org
www.sheepdrove.com

Relevant research on health impacts of organic food

A recent human cohort study into the effect of organic milk consumption on eczema in children younger than 2 years in the Netherlands reported that eczema was significantly reduced in children from families consuming organic rather than non-organic milk (Kummerling *et al.* 2008). The authors suggested that this may have been caused by the higher n-3 fatty acid concentrations in organic milk, since there is increasing evidence for anti-allergic effects of n-3 fatty acids (Calder *et al.* 2010).

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Transforming the way we eat, farm and care for our natural world. The Soil Association is the UK's leading charity for healthy and planet-friendly food and farming.

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"The crucially important thing about this research is that it shatters the myth that how we farm does not affect the quality of the food we eat."

Helen Browning OBE, Chief Executive, Soil Association

Neal's Yard Remedies is a proud supporter of the Newcastle University-led study and its findings

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