

U.K. Food Standards Agency Study Does Not Reflect Latest Science and Fails to Focus on Antioxidant Content --A Key Nutritional Benefit of Organic Food

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An advance copy of a study appeared today that will be published in the September edition of the *American Journal of Clinical Nutrition*. The published paper, "Nutritional quality of organic foods: a systematic review," was written by a team led by Alan Dangour, at the London School of Hygiene and Tropical Medicine and funded by the United Kingdom's Food Standards Agency (FSA).

In their written report, the London team downplayed positive findings in favor of organic food. In several instances, their analysis showed that organic foods tend to be more nutrient dense than conventional foods. Plus, their study omitted measures of some important nutrients, including total antioxidant capacity. It also lacked quality controls contained in a competing study released in 2008 by The Organic Center (TOC). Last, the FSA-funded team also used data from very old studies assessing nutrient levels in plant varieties that are no longer on the market.

The London team reported finding statistically significant differences between organically and conventionally grown crops in three of thirteen categories of nutrients. Significant differences cited by the team included nitrogen, which was higher in conventional crops, and phosphorus and tritrateable acids, both of which were higher in the organic crops. Elevated levels of nitrogen in food are regarded by most scientists as a public health hazard because of the potential for cancer-causing nitrosamine compounds to form in the human GI tract. Hence, this finding of higher nitrogen in conventional food favors organic crops, as do the other two differences.



Despite the fact that these three categories of nutrients favored organic foods, and none favored conventionally grown foods, the London-based team concluded that there are no nutritional differences between organically and conventionally grown crops.

A team of scientists convened by The Organic Center (TOC) carried out a similar, but more rigorous, review of the same literature. The TOC team analyzed published research just on plant-based foods. Results differ significantly from the more narrow FSA review and are reported in the study “New Evidence Confirms the Nutritional Superiority of Plant-Based Organic Foods,” which is freely accessible on the TOC website (http://www.organic-center.org/science.nutri.php?action=view&report_id=126).

The TOC findings are similar for some of the nutrients analyzed by the FSA team, but differ significantly for two critical classes of nutrients of great importance in promoting human health – total polyphenols, and total antioxidant content. The FSA team did not include total antioxidant capacity among the nutrients studied, and it found no differences in the phenolic content in 80 comparisons across 13 studies.

Unlike the London study, The Organic Center review focused on nutrient differences in “matched pairs” of crops grown on nearby farms, on the same type of soil, with the same irrigation systems and harvest timing, and grown from the same plant variety. It also rigorously screened studies for the quality of the analytical methods used to measure nutrient levels, and eliminated from further consideration a much greater percentage of the published literature than the FSA team.

While the FSA team found 80 comparisons of phenolic compounds, the TOC team focused on the more precise measure of total phenolic acids, or total polyphenols, and found just 25 scientifically valid “matched pairs.” By mixing together in their statistical analysis the results of several specific phenolic acids, the FSA team likely lost statistical precision. Instead, the TOC team focused on studies reporting values for total phenolic acids, and also applied more rigorous selection criteria to exclude poorer quality studies.

The TOC team found –

- Twenty-five matched pairs of organic and conventional crops for which total phenolic acid data was reported. The levels were higher in the organic crops in 18 of these 25 cases, conventional crops were higher in 6. In five of the matched pairs, phenolic acid levels were higher in organic crops by 20% or more. On average across the 25 matched pairs, total phenolics were 10% higher in the organic samples, compared to conventional crops.
- In seven of eight matched pairs reporting total antioxidant capacity data, the levels were higher in the organically grown crop. Of 15 matched pairs for the key antioxidant quercetin, 13 reported higher values in the organic food. In the case of kaempferol, another important antioxidant, the organic samples were higher in six cases, while five were higher in the conventional crops.



In the TOC study, there were an ample number of matched pairs to compare the levels of 11 nutrients, including five of the nutrients in the FSA review. For the five nutrients covered in each review, the TOC team was in general agreement with the FSA findings for two (nitrogen and phosphorus).

The London team did not assess differences in key individual antioxidants, nor in total antioxidant activity, important nutrients that have been measured in several more recent studies.

Across all the valid matched pairs and the 11 nutrients included in the TOC study, nutrient levels in organic food averaged 25% higher than in conventional food. Given that some of the most significant differences favoring organic foods were for key antioxidant nutrients that most Americans do not get enough of on most days, the team concluded that the consumption of organic fruits and vegetables, in particular, offered significant health benefits, roughly equivalent to an additional serving of a moderately nutrient dense fruit or vegetable on an average day.

Why the Different Results?

A review of the London-based team's methodology and study design points clearly to why the FSA and Organic Center studies reached some different conclusions.

Inclusion of Older Studies

The FSA review included studies over a 50-year period: January 1958 through February 2008. The TOC team included studies published since 1980. Most studies published before 1980 were found flawed for purposes of comparing the nutrient content of today's conventional and organic crops.

Most of the older studies used plant varieties no longer in use, and did not measure or report total phenolics or antioxidant capacity (since these nutrients were just being discovered). The older studies used analytical methods that are now considered inferior, compared to modern methods.

Further, since the 1950s, plant breeders and growers have consistently increased the yields of food crops, leading, in some cases, to a dilution of nutrients. In 2004, one of us (Donald R. Davis) reported evidence for a general decline in some nutrient levels in 43 garden crops between 1950 and 1999 (Davis et al., "Changes in USDA Food Composition Data for 43 Garden Crops, 1950 to 1999," *Journal of the American College of Nutrition*, Vol. 23(6): 669-682). Similarly, an Organic Center report describes in detail the evidence linking higher yields and nutrient decline ("Still No Free Lunch: Nutrient levels in the U.S. food supply eroded by pursuit of high yields," by Brian Halweil, access at http://www.organic-center.org/science.nutri.php?action=view&report_id=115).

Thus, results in the FSA study are likely confounded by the team's decision to include data from over three decades ago.

New Studies Support Greater Nutrient Density in Organic Foods

Since February 2008, the cut-off date of the London study, some 15 new studies have been published, most of which use superior design and analytical methods based on criticisms of older studies. The



Organic Center is updating its earlier analysis with these additional studies. These new studies generally reinforce the findings reported in the March 2008 TOC report, particularly in the case of nitrogen (higher in conventional crops, a disadvantage), and Vitamin C, total phenolics, and total antioxidant capacity, which are typically higher in organically grown foods.

The Center's study finds that protein content and beta-carotene, a precursor of Vitamin A, are typically higher in conventionally grown foods, but since both are present at ample or excessive levels in the diets of most Americans, these differences do not confer a nutritional advantage nearly as important as heightened levels of phenolics and antioxidants in organic foods.

Exclusion of Studies Analyzing Results on "Integrated" Farms

The FSA team excluded studies comparing organic foods to "integrated" and biodynamic production systems, stating that "integrated" systems are not conventional. Most conventional U.S. fruit and vegetable producers are now using advanced levels of Integrated Pest Management. Thus, "integrated" systems are now a more accurate description of "conventional" agriculture in the U.S., than a definition grounded in monoculture, the calendar spraying of pesticides, and excessive applications of chemical fertilizers. The London team did not report in the published paper which "integrated" studies were dropped, but we suspect some important U.S.-based studies may have been eliminated.

TOC Study Applied Much Stricter Screens for Scientific Validity

The two teams agree that many published studies are methodologically flawed, and hence should not be included in comparative studies. But the FSA and TOC teams used very different rules to screen studies for scientific quality and to select matched pairs for analyses.

The FSA team cites five criteria: definition of the organic system; specification of the plant variety (i.e., crop genetics); statement of nutrients analyzed; description of laboratory method used; and, a statement regarding statistical methods for assessing differences. The London team states that they simply required some discussion of these issues in published papers, but did not set or apply any qualitative thresholds in judging scientific validity.

The Organic Center team focused on the same factors (plus several others) and used stated, objective criteria for assessing them. The TOC team reviewed the statistical power and reliability of the analytical methods, a process that eliminated dozens of results. Finally, the TOC team insisted upon a close match of soils, plant genetics (variety), harvest method and timing, and irrigation systems, all factors that can bias the results of a comparison study.

Inclusion of Market-Basket Studies

The FSA team included some market basket studies, for which there is no way to know the specific circumstances of the farm locations, the plant genetics, the soil type, or harvest method and timing. In the Organic Center study, market basket results were judged as "invalid" based on several quality-control screening criteria.

