

WATER TREATMENT

Sweeteners Persist in Waterways

Artificial sweeteners are widespread in European sewage treatment plant effluent, waterways, groundwater, and even drinking water, a growing body of research demonstrates. One of the latest studies, published in the July 2009 issue of *Analytical and Bioanalytical Chemistry*, presents data on four common sweeteners found in German water and demonstrates the persistence of these additives. Two, acesulfame and sucralose, were remarkably resistant to treatment by conventional sewage treatment plants as well as by a more advanced soil aquifer treatment plant, report environmental engineer Marco Scheurer and colleagues from the Water Technology Center in Karlsruhe.

In samples taken from four German rivers, concentrations of acesulfame exceeded 2 µg/L, whereas concentrations of sucralose, cyclamate, and saccharin were an order of magnitude lower. Coauthor Frank T. Lange, an analytical chemist, notes that a person would have to drink 2–3 L of water with sweetener concentrations similar to those of the German rivers every day for years before they would consume the amount contained in a single sweetener tablet (the concentrations detected in water were well below human taste thresholds). Three other sweeteners—aspartame, neotame, and neohesperidin dihydrochalcone—were not detected in any of the samples.

The findings echo those of four recent studies documenting artificial sweeteners in sewage treatment plant effluent and waterways throughout Europe. Preliminary results from two separate studies—one unpublished and one accepted 11 September 2009 for publication in *Marine Chemistry*—also show sucralose in Arizona wastewater treatment plant effluent and several downstream rivers, as well as in coastal and Gulf Stream waters off the southeastern United States.

Acesulfame and sucralose, which is sold in the United States as Splenda®, have proven to be the most commonly found and resilient sugar substitutes. They are added to a wide variety of foods, beverages, pharmaceuticals, and toiletries, and they pass through the human body virtually unchanged. Cyclamate and saccharin are much less persistent.

Cyclamate has been banned in the United States since 1970 as a possible human carcinogen, but the Food and Drug Administration is considering reapproval. And although saccharin has been found to cause cancer in rats, it is considered safe for human consumption.

All the sources interviewed for this article agree there's little risk that acesulfame and sucralose in drinking water will cause human health problems. The implications for the aquatic environment are less clear, however. Because these sweeteners have been classified as safe for human consumption, they have undergone virtually no environmental testing. Yet the remarkable persistence of acesulfame and sucralose gives some experts pause, given that environmental concentrations will likely rise over time with continued consumption.

Henrik Kylin, an environmental chemist at the Norwegian Institute for Air Research and a coauthor of a study on sucralose presented at the Society of Environmental Toxicology and Chemistry Europe 17th Annual Meeting in 2007, points out that sucralose mimics sucrose, a structurally similar molecule involved in biological functions from the regulation of genes related to photosynthesis to feeding cues in zooplankton. "If those [functions] are affected, you may end up with serious ecosystem effects," he says.

Kylin is also concerned by the finding, reported in the October 2006 issue of *Plant, Cell & Environment*, that sucralose at least partially inhibited sucrose transport in sugarcane. "There are very many vascular plants in the aquatic ecosystem," he says, "and if they are [similarly] affected, it would affect very many other organisms."

Rosa Krajmalnik-Brown, an assistant professor of environmental biotechnology at Arizona State University, has been working for more than two years to identify a microorganism that can degrade sucralose and hasn't found one yet—although she says she's not giving up. Still, there may be a bright side to sweeteners' persistence: Scheurer and other researchers have proposed using them as markers for detecting wastewater spills—a welcome finding for scientists who have long sought a failsafe marker.

Rebecca Kessler, based in Providence, Rhode Island, is a senior editor at *Natural History* and writes about science and the environment for various publications. She is a member of the National Association of Science Writers and the Society of Environmental Journalists.

The Beat

by Erin E. Dooley

Vehicles Concentrate Nicotine

A study by Patrick Breyse et al. published online 25 August 2009 ahead of print in *Tobacco Control* found that vehicle passengers riding with smokers may be exposed to nicotine levels 40–50% higher than those found in restaurants and bars that permit smoking. Nicotine

concentrations inside vehicles increased twofold for every cigarette smoked, and while opening the windows reduced smoke somewhat, it did not eliminate exposure within the vehicle. Breyse et al. state the levels are unacceptable for nonsmoking passengers, especially children, who are at increased risk for secondhand smoke-related health problems.

USDA Maps Local Food Production

Until recently, low fuel prices meant the U.S. food system could rely on food imported from other countries, but rising transport costs and regional food shortages and crop failures are among several factors encouraging a closer look at local food production. Wayne Honeycutt and colleagues at the Agricultural Research Service are now mapping data from Maine to Virginia on weather, soil, land use, and water availability to model potential crop production and determine local food production capacity. They say expanding opportunities for local food production could stimulate rural development and offset the risk of food shortages by diversifying and increasing local production in other areas.



School Averts EMF-Related Closure

The debate over the safety of electromagnetic fields (EMFs) nearly closed a New Jersey school this fall until the state's biggest electric utility and the Sussex County Board of Education reached an eleventh-hour settlement. The board had planned to close the K–6 Fredon Township School 1 October 2009 because the existing high-voltage power line crossing the school's playground had been found to



DIET AND NUTRITION

Next Course in Organic Debate

With the Northern Hemisphere's peaking summer produce crop came a new iteration of the question of whether organic food is worth the extra expense. According to a review commissioned by the U.K. Food Standards Agency and published 29 July 2009 ahead of print in the September 2009 *American Journal of Clinical Nutrition*, organically grown food is no more nutritious than conventionally grown food. But organic proponents question the findings and also note that the health benefits of organic agriculture can go beyond nutrition.

The review authors identified more than 52,000 studies dating back to 1958 that compared organic and conventional foods. Of these, 55 studies were deemed of sufficient quality. None of the studies predate 1990—an important point, says first author Alan D. Dangour, a senior lecturer at the London School of Hygiene & Tropical Medicine, because one chief criticism of the review has been the fact that agriculture has changed markedly over the past 60 years.

Of 11 parameters examined, organic crops had significantly higher phosphorus content and titratable acidity (which is not a nutrient but a food processing metric) whereas conventional crops had higher nitrogen content. Differences in levels of vitamin C, phenolic compounds, magnesium, calcium, potassium, zinc, total soluble solids (mostly sugar), and copper were insignificant.

The results contradict a review published as the report *New Evidence Confirms the Nutritional Superiority of Plant-Based Organic Foods* in March 2008 by The Organic Center, a nonprofit food research outfit. This review found that total phenolics, vitamin E, vitamin C, quercetin, and total antioxidant capacity of organics exceeded that of conventionally grown produce—in the case of total antioxidant capacity, by 80%. Conventional products had higher levels of potassium, phosphorus, and total protein, all basic constituents of conventional fertilizers. Nutrition scientist Denis Lairon reported similar findings in a review published online 8 July 2009 ahead of print in *Agronomy for Sustainable Development*.

Charles Benbrook, The Organic Center's chief scientist and coauthor of the *New Evidence* report, criticizes the U.K. review for not requiring the individual studies to have used the same cultivars on organic and conventional plots. Differences in plant varieties—for instance, between hybrid and heirloom varieties of tomatoes—can result in dramatic differences in nutrient content, he says. “We went with what was available,” responds Dangour. “In general I recall most studies compared the same cultivars.”

Another criticism: the study did not require organic fields to have been used as such for a minimum number of years. “We know from a large body of research that the biological benefits of organic farming mostly come from improvements in soil quality,” says Benbrook. Moreover, long-term studies of organic and conventional tomatoes by food chemist Alyson Mitchell at the University of California, Davis, have demonstrated that soil organic matter takes at least five years to reach optimal levels. And national standards defining organic production practices were not established until 2002.

Mitchell cautions against drawing sweeping conclusions from comparison studies of organic versus conventional. She notes that organic practices vary immensely, with some modern industrial-scale organic farms using methods more similar to those of conventional farms, such as growing just a single crop (monoculture).

But Benbrook says sustainably conducted organic farming offers benefits beyond nutrition, including improved health of pollinators and cleaner waterways resulting from minimal pesticide use, significant carbon sequestration as soil builds up through organic cultivation, and potential shrinkage of oceanic dead zones due to reduced nitrogen fertilizer pollution. Melissa Perry, an associate professor of occupational epidemiology at the Harvard School of Public Health, also says children on organic diets have shown significantly lower levels of pesticide metabolites in their urine than children on conventional diets. As to the dangers thereof, Perry says the risk assessments conducted so far by the Environmental Protection Agency are limited because they do not routinely account for cumulative and potentially synergistic effects of multiple pesticides.

David C. Holzman writes from Lexington and Wellfleet, Massachusetts, on science, medicine, energy, economics, and cars. He has written for *EHP* since 1996.

emit EMF levels more than 8 times the WHO-recommended maximum of 3 milligauss. Under the settlement, Public Service Electric & Gas Co. agreed to pay \$95,000 to relocate playgrounds located under its lines. There is limited evidence that EMFs from power lines may be a risk factor for childhood leukemia.

Colorimetric “Nose” Alerts Chemical Handlers

In a report published online 13 September 2009 in *Nature Chemistry*, Kenneth Suslick and colleagues present a postage stamp-sized electronic sensor capable of quickly and inexpensively detecting toxic chemicals and their concentrations through color visualization. The pattern created by color changes in the disposable 36-dye sensor array identifies both the toxicant and its concentration. The sensor can detect more chemicals than previous methods and produces most results within 2 minutes. The researchers have developed a handheld version similar to a card-scanning device that uses LED illumination and an ordinary camera.

Take-Home Dust Boosts Car Seat Lead Levels

Several studies have established that lead-exposed workers can carry lead-contaminated dust off the jobsite on their clothing, shoes, and tools. In the 21 August 2009 *MMWR* Tina Bernier et al. report the first known cases of childhood lead poisoning attributed to take-home lead dust deposited onto car safety seats. No contamination was found in the six children's homes, leading the researchers to examine family vehicles and car seats, where high lead levels were found. Although previous studies have recommended monitoring blood lead levels among children of lead-exposed workers, no standards exist for levels of lead dust contamination in vehicles or on child car safety seats.

Indoor Greenery Releases VOCs

Peace lilies, snake plants, weeping figs (ficus trees), and areca palms are just a few of the houseplants that have been shown to remove volatile organic compounds (VOCs) from indoor air, but a new study by Dong Sik Yang et al. in

the August 2009 issue of *HortScience* finds they can also release these chemicals. The authors found these four types of houseplants released 12–23 VOCs, and although the researchers did not quantify potential exposures, they did note that emissions were higher during the day than at night. The authors attributed the VOCs to pesticides used in nurseries, microorganisms living in the growing medium, and offgassing of plastic planters.

