Superfund Research Program

The Superfund Research Program (SRP) supports practical research that creates benefits, such as lower environmental cleanup costs and reduced risk of exposure to hazardous substances, to improve human health. SRP funds colleges, universities, and small businesses, including the University of Kentucky Superfund Research Center (UK SRC), to advance this work across the nation.

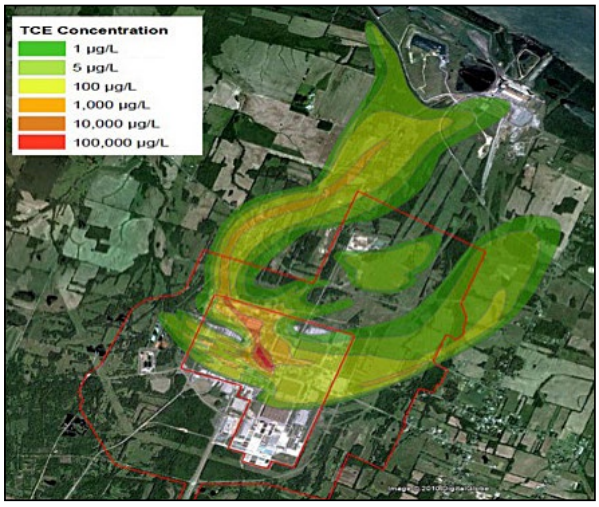
Nutrition protects against toxicity

Even with the best cleanup efforts, it is nearly impossible to remove all harmful chemicals at a site. Other ways to lessen harmful effects are needed. To this end, Bernhard Hennig, Ph.D., leads a research program studying how diet affects the toxicity of environmental contaminants. His team discovered that some food components can interfere with cellular function, while others can protect against cell damage. They found that the type of fat in a diet, not just the amount, can reduce cell damage triggered by polychlorinated biphenyls (PCBs).[1] For example, Hennig found that a diet with a high ratio of omega-3 to omega-6 fatty acids, or diets supplemented with green tea, can reduce cell and tissue damage caused by PCBs and other pollutants.[2] They also found diets rich in polyphenols, which are antioxidants found in fruits, vegetables, and other plant foods, can protect against PCB-induced blood vessel, or vascular, inflammation and associated diseases.[1]

Salmon is a good source of omega-3 fatty acids.

Water purifier harnesses the use of nanomembranes

Given that water is the basis of life, Dibakar Bhattacharyya, Ph.D., and other scientists developed a system to improve drinking water quality by reducing the risk of contamination. Their system removes chlorinated organic contaminants, such as trichloroethylene (TCE), from groundwater.[3] The functionalized, iron-based nanomembrane cleanup device may offer an inexpensive way to provide clean drinking water in areas of the world where chemical contamination is common. The technology may also remove toxic selenium, used in coal-burning power plants, from water.



TCE plumes at the Paducah Gaseous Diffusion Plant. (Photo courtesy of UK SRC)

Lindell Ormsbee, Ph.D., is working closely with Bhattacharyya to employ the nanomembrane technology at the Paducah Gaseous Diffusion Plant in Kentucky, the state's largest Superfund site. This technology can also be used to break down PCBs into harmless byproducts by using inexpensive oxidative processes.

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Research efforts at UK SRC focus on reducing exposures to hazardous substances. They are working to understand how nutritional components, such as antioxidants and plant-derived polyphenols, can be used to counteract negative health effects in people exposed to harmful chemicals, such as chlorinated organic compounds. These chemicals include PCBs and TCE, which are common at Superfund sites in Kentucky and nationwide. They also work toward developing strategies to improve detection of, and reduce exposure to, these harmful chemicals.

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PCB exposure may contribute to obesity

PCB exposure, even at low levels, may contribute to the development of obesity and obesity-associated diseases, according to research led by Lisa Cassis, Ph.D. Her team found that exposure to PCBs can result in increased body fat and produce inflammation in fat cells, called adipocytes, increasing risk for diabetes and cardiovascular disease.[4]

Despite a production ban in 1979, and decades of cleanup efforts, the structural stability of PCBs allows them to remain a persistent environmental contaminant and accumulate in the food chain.[5] Obesity is common, serious, and costly. More than one-third of U.S. adults (34.9 percent) are obese. The estimated annual medical cost of obesity in the U.S. was $147 billion in 2008.[6]

Research overview

- Identifying plant-based bioactive food components with antioxidant and anti-inflammatory properties that may lessen the toxicity of PCBs to the layer of cells that line blood vessels. (Bernhard Hennig, Ph.D., bhennig@uky.edu)
- Collaborating with a membrane manufacturing company, ULTURA Inc. of Long Beach, California, to develop a full-scale, functionalized membrane filter for water cleanup applications, which also may have other uses, including disinfection and virus inactivation. (Dibakar Bhattacharyya, Ph.D., db@engr.uky.edu)
- Developing new pollutant sensing and capture systems that use nontoxic, biology-inspired, specialized nanocomposites for selective, sensitive, and inexpensive monitoring and removal of PCBs from contaminated sites. (J. Zach Hilt, Ph.D., zach.hilt@uky.edu)
- Identifying how PCBs affect body metabolic processes and increase risk for Type 2 diabetes, and whether resveratrol, an antioxidant found in certain plant foods, can be used to prevent or treat PCB-induced harm in fat cells. (Lisa Cassis, Ph.D., lcassis@uky.edu)
- Studying molecular mechanisms involved in postnatal complications following perinatal PCB exposure, and how diet and exercise can be used as health interventions. (Kevin Pearson, Ph.D., kevin.pearson@uky.edu)

Sharing results

- UK SRC shares nutrition research findings with the general public, including Superfund communities in Kentucky. (Lisa Gaetke, Ph.D., lgaetke@uky.edu)
- UK SRC communicates relevant findings to government officials and regulators, strengthens partnerships with other agencies and universities, and supports implementation of project technologies. (Lindell Ormsbee, Ph.D., lormsbee@engr.uky.edu)

Other contributions to advance science

- The UK SRC research support facility provides vital access to expertise, research resources, and state-of-the-art instrumentation for its research projects. (Andrew Morris, Ph.D., a.j.morris@uky.edu)
- The UK SRC integrated, multidisciplinary training experience provides early-career scientists access to teams of diverse professionals and encourages innovation to develop solution-oriented approaches to complex environmental health problems. (Bernhard Hennig, Ph.D., bhennig@uky.edu)

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For more information on the National Institute of Environmental Health Sciences, visit **www.niehs.nih.gov**.

For more information on the Superfund Research Program, visit **www.niehs.nih.gov/srp**.

For more information on the University of Kentucky Superfund Research Center, visit **www.uky.edu/research/superfund**.

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