Chemists develop safe alternatives to phthalates used in plastics

November 1 2018

Rebecca Braslau's lab has been working to develop nonmigratory plasticizers that can't leach out of plastics and contaminate food and the environment. Credit: Carolyn Lagattuta

Researchers at UC Santa Cruz have developed safer alternatives to the phthalate plasticizers used to enhance the suppleness, flexibility, and longevity of plastics.

The problem with phthalates is that they leach out of plastics into food, water, and the environment, and there is mounting evidence suggesting that phthalate exposure can lead to a variety of health problems.

Researchers led by Rebecca Braslau, professor of chemistry and biochemistry at UC Santa Cruz, addressed this problem by developing chemicals that are effective as plasticizers for polyvinyl chloride (PVC) but can't leach out of PVC products because they are chemically bonded to the polymer chain. The team reported their findings in a paper published in the *Journal of Polymer Science* (online September 26 and in the November 1 print issue).

Phthalates are used in a wide variety of products, but their most widespread use is as plasticizers for PVC, one of the most common types of plastic. After polypropylene and polyethylene, PVC is the third most common plastic polymer and is used to make products such as building materials, furniture, clothing, garden hoses, food packaging, blood-storage containers, and medical devices.

Braslau's team has been working to develop "nonmigratory" plasticizers that attach to the PVC polymer via a chemical bond and can't leach out of the plastic. She explained that traditionally, phthalates are mixed with fine-ground PVC and "melted together" rather than being bonded.

"Unlike phthalates, our nonmigratory plasticizers physically can't leach out," Braslau said.

Her lab has produced several viable nonmigratory plasticizers, including two dubbed the "frog" and the "tadpole" because of their chemical structures. The "tadpole" is particularly promising, Braslau said, because it is much easier to produce than the "frog" and is the most effective of the plasticizing strategies examined.

"Fewer steps and fewer chemicals are involved in its synthesis. Importantly, it should be scalable for industrial use," she said.

The research into phthalate alternatives was prompted by growing concerns about the potential health risks posed by phthalates. Certain phthalates are considered endocrine disruptors because they or their metabolites interfere with the body's hormone system. Most of the studies showing harmful effects have been done in lab animals, but some human studies have also found associations between exposure to phthalates and adverse reproductive and developmental effects.

How phthalates affect human health and at what levels of exposure are still unresolved questions, but researchers are particularly concerned about potential effects on infants and children. Bans on the use of phthalates in children's toys and childcare products have been imposed by both the European Union and the United States.

Nevertheless, the use of phthalates in other products remains widespread. They are found in vinyl siding and flooring, shower curtains, children's rain gear, and even in personal care products such as shampoos and cosmetics. As a result, phthalates are now widely dispersed throughout the environment, and most people have detectable amounts in their blood.

"They are everywhere we touch," Braslau said.

Eventually, Braslau and her team hope to see their safer nonmigratory plasticizers adopted by the plastics industry.

"The potential for this is real," she said, though she admitted that trying to change the plastics industry is like "trying to turn the Queen Mary."

More information: Chad M. Higa et al, Nonmigratory internal

plasticization of poly(vinyl chloride) via pendant triazoles bearing alkyl or polyether esters, *Journal of Polymer Science Part A: Polymer Chemistry* (2018). DOI: 10.1002/pola.29205