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Suspicion lingers over bisphenol A and breast cancer

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BLOOMINGTON, Ind. -- Bisphenol A, a common industrial chemical claimed to speed the growth of human breast and ovarian cancers, retains its carcinogenic properties even after being modified by body processes, report Indiana University and University of California at Berkeley scientists in the Aug. 28th issue of *Chemistry & Biology*, a Cell Press

Media Contacts

David Bricker

IU Media Relations

brickerd@indiana.edu

812-219-8308

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journal.

Defenders of bisphenol A's use have argued that its natural modification inside the human body renders the estrogen-like chemical harmless.

"We tested whether this chemical modification -- the addition of sulfate to BPA -- keeps the chemical from being absorbed by breast tumor cells," said IU Bloomington biochemist Theodore Widlanski, who led the project. "We've shown that modified versions of bisphenol A likely to be formed in the body do stimulate breast tumor cell growth *in vitro*. Enzymes present on the surface of breast tumor cells appear to convert the modified BPA back into BPA."

BPA is a plasticizer present at low levels in mineral water bottles, CDs and DVDs, car parts and other household products. A recent U.S. Center for Disease Control and Prevention study found trace amounts of BPA in 95 percent of urine samples collected from American adults.

The researchers present a model for the selective uptake of BPA into breast

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cancer cells by implicating human enzymes that sulfate and de-sulfate BPA.

One of those enzymes, estrogen sulfotransferase, adds sulfate to estrogen, making the molecule water soluble and easily transportable through the bloodstream. Widlanski's collaborators showed that BPA, too, can be sulfated by estrogen sulfotransferase.

Breast cancer cells are known to overproduce an enzyme that other, healthier cells don't -- aryl sulfatase C. Aryl sulfatase C removes sulfate from estrogen, allowing the hormone's absorption into cells. In the present *Chemistry & Biology* paper, Widlanski's group shows aryl sulfatase C can also de-sulfate BPA, and that the concentration of non-sulfated BPA inside breast cancer cells goes up when the cells are grown in a medium containing sulfated BPA.

That human enzymes are capable of the sulfation and desulfation of BPA suggests breast cancer cells are a lightning rod not only for natural estrogen, but for BPA too, Widlanski said.

Widlanski cautions those who would misinterpret the results of the study.

"We have not shown this process takes place *in vivo*," he said. "We have only demonstrated a possible mechanism that explains what people have been speculating about for years. It doesn't mean that your bottled water is any less safe today than it was yesterday. It just means that if it isn't safe, we might be able to explain why."

Widlanski said that he has always been a skeptic of claims that BPA causes or speeds the development of cancer and birth defects. "All along we set out to show the opposite -- that BPA is not harmful. If any of the answers to our questions had been 'no,' then we would have concluded BPA was not dangerous. But we can't do that, or we can't do it yet."

The researchers subjected cancer cells and enzymes to extremely high concentrations of BPA and BPA derivatives -- levels not ordinarily experienced by human beings. Widlanski said his group did this in order to simulate the cumulative effects of low BPA concentrations of the course of

a human lifetime.

"If our hypothesis is true about BPA, it's probably going to be the sum of effects of a lot of cancer-causing compounds that is responsible for the disease," Widlanski said. "We would not anticipate that BPA or any other single chemical is the only culprit here."

The researchers used a line of MCF-7 breast cancer cells provided by the Medical Sciences Program in Bloomington as well as purified enzyme extracts. IU School of Medicine physiologist Robert Bigsby and retired endocrine researcher Peter C.M. Young, IU Bloomington chemistry graduate student Cheri Stowell, UC Berkeley biochemist Carolyn Bertozzi and graduate student Dawn Verdugo, and biochemist Kevin Barvian also contributed to the report. Barvian was a graduate student at IU Bloomington during the research phase of the project. It was funded with grants from the National Cancer Institute and the U.S. Army.

To speak with Widlanski, please contact David Bricker, IU Media Relations, at 812-856-9035 or brickerd@indiana.edu.

"A Role for Sulfation-Desulfation in the Uptake of Bisphenol A into Breast Tumor Cells," *Chemistry & Biology*, vol. 13, iss. 8