

Major 'third-hand smoke' compound causes DNA damage—and potentially cancer

March 17 2014

Leftover cigarette smoke that clings to walls and furniture is a smelly nuisance, but now research suggests that it could pose a far more serious threat, especially to young children who put toys and other smoke-affected items into their mouths. Scientists reported today that one compound from this "third-hand smoke," which forms when second-hand smoke reacts with indoor air, damages DNA and sticks to it in a way that could potentially cause cancer.

Their talk was one of more than 10,000 presentations at the 247th National Meeting & Exposition of the American Chemical Society (ACS).

Bo Hang, Ph.D., who presented the research, said that although the idea of third-hand smoke made its debut in research circles just a few years ago in 2009, evidence already strongly suggests it could threaten human health.

"The best argument for instituting a ban on smoking indoors is actually third-hand smoke," said Hang, a scientist at Lawrence Berkeley National Laboratory (LBNL).

Researchers have found that many of the more than 4,000 compounds in second-hand smoke, which wafts through the air as a cigarette is smoked, can linger indoors long after a cigarette is stubbed out. Based on studies led by Hugo Destailats, Ph.D., also at LBNL, these substances can go on to react with indoor pollutants such as ozone and nitrous acid,

creating brand-new compounds, some of which may be carcinogenic.

One of those compounds goes by the acronym NNA. Hang's research has shown that NNA, a tobacco-specific nitrosamine, locks onto DNA to form a bulky adduct (a piece of DNA bound to a cancer-causing chemical), as well as other adducts, in lab test tubes. Other large compounds that attach to DNA tend to cause genetic mutations. NNA also breaks the DNA about as often as a related compound called NNK, which is a well-studied byproduct of nicotine and a known potent carcinogen. This kind of DNA damage can lead to uncontrolled cell growth and the formation of cancerous tumors.

Just as it took years to establish the cancer-causing effects of first-hand smoke that is inhaled as a person breathes in directly from the cigarette, making the connection between third-hand smoke or NNA and cancer could take a long time, Hang said. But early research into its nature, exposure and health effects is compelling enough that a research consortium dedicated to investigating third-hand smoke was formed in California in 2010. That consortium helped fund Hang's work on NNA-induced DNA damage, which he said could eventually be used as biomarkers to identify people who have been exposed to third-hand smoke.

The biggest potential health risk is for babies and toddlers, he noted. As they crawl and put their hands or toys in their mouths, they could touch, swallow or inhale [compounds](#) from third-hand smoke. Their small size and early developmental stage make them more vulnerable than adults to the effects of environmental hazards.

Although many public places prohibit smoking, Hang noted that people can still smoke in most rental apartments and private residences—and smoking remains a huge public health issue. In 2011, nearly 44 million American adults reported smoking cigarettes, which ranks as the leading

cause of preventable death in this country. And 34 million people smoke every day, according to data from the Centers for Disease Control & Prevention.

So far, the best way to get rid of third-hand smoke is by removing affected items, such as sofas and carpeting, as well as sealing and repainting [walls](#), and sometimes even replacing contaminated wallboard, he explained. Replacing [furniture](#) can be pricey, but Hang said vacuuming and washing clothes, curtains and bedding can also help.

More information: NNA, a thirdhand smoke constituent, induces DNA damage in vitro and in human cells:

Abstract

Thirdhand smoke (THS) exposure is a potential new health risk as recent indoor chemistry studies have revealed that sorbed nicotine reacts with the common indoor pollutant nitrous acid (HONO) to form mutagenic tobacco-specific nitrosamines (TSNAs). 1-(N-methyl-N-nitrosamino)-1-(3-pyridinyl)-4-butanal (NNA) is the major TSNA product identified from THS, and is absent in freshly emitted secondhand smoke. We recently examined the genotoxicity of NNA in human HepG2 cells as well as its ability to modify both 2-deoxyguanosine (dGuo) and 2-deoxycytidine (dCyt) in vitro. In alkaline comet assay, it caused concentration-dependent DNA strand breaks in HepG2 cells at non-cytotoxic concentrations ranging from 0.01 mM to 100 mM for 24 hours. In the reaction of NNA with dGuo, several adducts were identified with HPLC-UV spectrum, ESI-MS/MS and NMR. These include 8-oxo-2'-deoxyguanosine (8-oxo-dG), O6-methyl-dG, and N2-methyl-dG. NNA also forms a bulky dG adduct with m/z 455.17 for $(M+H)^+$ in mass spectrum, which is due to the condensation of NNA and dG with the elimination of H₂O and two hydrogen molecules. In addition, NNA causes novel DNA sugar damage, forming 5' & 3'-methyl-dG. Taken together, these results provide evidence for

the DNA damaging potential of NNA, which, in part, may contribute to THS-induced adverse health effects in humans. In addition, the NNA-specific DNA adducts identified can be used as specific biomarkers of THS exposure.

Provided by American Chemical Society

Citation: Major 'third-hand smoke' compound causes DNA damage—and potentially cancer (2014, March 17) retrieved 9 April 2024 from <https://medicalxpress.com/news/2014-03-major-third-hand-compound-dna-damageand.html>

<p>This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.</p>
--