Some chemicals in smoke may be even more dangerous than previously thought

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Alison Bauer, PhD, and colleagues show that while single chemicals in combustion may not cause cancer, combinations can be dangerous. Credit: University of Colorado Cancer Center

It's no surprise that chemicals in smoke cause cancer, but a new study published in the *Archives of Toxicology* shows that some chemicals in cigarette smoke and industrial processes may be more dangerous than previously thought. Though most "low molecular weight polycyclic aromatic hydrocarbons" (LMW PAHs) have not been shown to cause cancer alone, the study shows that in common combinations, these chemicals can help to spark the disease.

"What we show is that testing each chemical in isolation may not give a complete picture of its danger," says Alison Bauer, PhD, investigator at the CU Cancer Center and assistant professor in Department of Environmental and Occupational Health at the Colorado School of Public Health. Bauer collaborated with colleagues at the Institute for Prevention and Occupational Medicine, Institute of the Ruhr-University Bochum (IPA) in Bochum, Germany.

The International Agency for Research on Cancer places possible carcinogens into four groups, depending on their degree of risk. Group 1, labeled "carcinogenic to humans", includes 120 known carcinogens such as benzene, radon and asbestos. It also includes the high molecular weight PAH benzo[a]pyrene or B[a]P, which has become known as one of the standard carcinogenic components associated with combustion. However, most LMW PAHs that are known components of combustion are not listed in Group 1. For example, the LMW PAHs fluoranthene and anthracene are currently listed in Group 3, titled "not classifiable as to its carcinogenicity to humans". Other LMW PAHs found in combustion such as 1-methylanthracene are not even listed.

In this study, Bauer and colleagues added fluoranthene and 1-methylanthracene to B[a]P and introduced the mixture to mouse cells. Of course, B[a]P alone was enough to cause cellular changes associated with the development of cancer. However, the researchers observed that these cellular changes were dramatically magnified when B[a]P was combined with fluoranthene and 1-methylanthracene, clearly indicating that these previously imprecisely categorized chemicals were acting as co-carcinogens with B[a]P.

"The effect was impressive," Bauer says.

The tested combination of PAHs (and many more like it) is not a hypothetical construct of the lab. Mixes of B[a]P with LMW PAHs are seen in many industrial processes such as coal gasification, paving and roofing work, vehicle emissions and cigarette smoke, among others.

"The goal is to prevent cancers associated with exposure to mixtures of these chemicals, through

increased awareness leading to protective behaviors or to additional regulation of these chemicals," Bauer says.

The group's next step is to explore carcinogenicity of this and other combinations of LMW PAHs in human cells.

More information: Alison K. Bauer et al, Environmentally prevalent polycyclic aromatic hydrocarbons can elicit co-carcinogenic properties in an in vitro murine lung epithelial cell model, *Archives of Toxicology* (2017). DOI: 10.1007/s00204-017-2124-5

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