Toxins produced by e-cigarettes vary by flavor

April 9 2018, by Katie Bohn

Credit: TheNorlo/Wikipedia

The flavor of an e-cigarette may affect more than a consumer's taste buds, according to Penn State researchers who say the chemicals that make up different flavors also produce different levels of free radicals, toxins often associated with cancer and other diseases.

The researchers analyzed popular e-cigarette flavors and the amount of

free radicals they produced and found that many of the chemicals used to flavor e-cigarettes increased the production of free radicals, while a few actually lowered it.

John Richie, professor of public health sciences and pharmacology, Penn State College of Medicine, said the results are an important step in learning more about the potential dangers of e-cigarettes.

"When these products first came on the market, many people were saying they were harmless and that it was just water vapor," Richie said. "We know that's not true, but we also don't have the numbers on how dangerous e-cigarettes are. But now we know that e-cigarettes do produce free radicals, and the amount is affected by the flavorants added."

Free radicals are unstable molecules that can cause damage to healthy cells, and have been linked to conditions like inflammation, heart disease and cancer. Consumers inhale these free radicals when they smoke a combustible cigarette.

While e-cigarettes do not give off smoke, they do contain many different chemicals to flavor the e-liquids, which are absent from traditional, or "combustible," cigarettes. The researchers said that while the flavorings are approved for consumption, they aren't evaluated for safety when heated.

"E-cigarettes have a coil for heating the liquid that gets quite hot and may aid the production of free radicals," Richie said. "It's important to look at the effect of flavors on these free radical levels because e-cigarettes come in hundreds of flavors, many of which are marketed toward kids, like bubblegum."

The researchers measured the free radicals produced by 50 flavors of a

popular brand of e-cigarette and compared them to flavorless e-liquid. They found that about 43 percent of the flavors were associated with significantly higher levels of free radical production, while a few were associated with lower levels.

Next, the researchers broke down the flavors into their individual chemicals to see which ones were associated with higher levels of free radicals. Zachary Bitzer, post-doctoral scholar, said isolating the chemicals was important because flavors are not consistent across brands.

"Two different manufacturers may sell an 'orange' flavored e-liquid, but they could each contain vastly different flavorants to get that orange flavor," Bitzer said. "Just like Coke and Pepsi are both colas but have different ingredients, different flavors of e-cigarettes may contain different flavorants, resulting in different levels of free radicals."

The researchers found six flavorants that significantly increased the production of free radicals. These flavorants included linalool, dipentene and citral, which are often used to give products citrus or floral notes. Additionally, the flavorant ethyl vanillin—often used for vanilla notes—decreased the production of free radicals by 42 percent.

Richie said the results—recently published in *Free Radical Biology and Medicine*—could help consumers make better decisions about the products they buy, as well as help policy makers create regulations around e-cigarettes in the future.

"We found that many of these flavorings increase free radicals, but a few decreased them, as well, which raises the possibility that maybe there are things you can add to these liquids that could reduce radical production and might make them safer," Richie said. "E-cigarettes are regulated by the Center for Tobacco Products in the FDA, and I think

these results can be useful to help set guidelines in terms of regulating these products."

More information: Zachary T. Bitzer et al, Effect of flavoring chemicals on free radical formation in electronic cigarette aerosols, *Free Radical Biology and Medicine* (2018). DOI: 10.1016/j.freeradbiomed.2018.03.020

Provided by Pennsylvania State University