

## Chemical flavorings found in e-cigarettes linked to lung disease

Focus on nicotine overshadowed other hazards attached to smoking device

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Diacetyl, a flavoring chemical linked to cases of severe respiratory disease, was found in more than 75 percent of flavored electronic cigarettes and refill liquids tested by researchers at Harvard T.H. Chan School of Public Health.

Two other related, potentially harmful compounds were also found in many of the tested flavors, which included varieties with potential appeal to young people such as cotton candy, “Fruit Squirts,” and cupcake.

The [study](#) was published online today in Environmental Health Perspectives.

The Occupational Safety and Health Administration and the flavoring industry have warned workers about diacetyl because of the association between inhaling the chemical and the debilitating respiratory disease bronchiolitis obliterans, colloquially known as “popcorn lung” because it first appeared in workers who inhaled artificial butter flavor in microwave popcorn processing facilities.

“Recognition of the hazards associated with inhaling flavoring chemicals started with ‘popcorn lung’ over a decade ago. However, diacetyl and other related flavoring chemicals are used in many other flavors beyond butter-flavored popcorn, including fruit flavors, alcohol flavors, and, we learned in our study, candy-flavored e-cigarettes,” said lead author Joseph Allen, assistant professor of exposure assessment sciences.

There are currently more than 7,000 varieties of flavored e-cigarettes and e-juice (nicotine-containing liquid that is used in refillable devices) on the market. Although the popularity and use of e-cigarettes continues to increase, there is a lack of data on their potential health effects. E-cigarettes are not currently regulated, although the U.S. Food and Drug Administration (FDA) has issued a proposed rule to include e-cigarettes under its authority to regulate certain tobacco and nicotine-containing products.

Allen and colleagues tested 51 types of flavored e-cigarettes and liquids sold by leading brands for the presence of diacetyl, acetoin, and 2,3-pentanedione, two related flavoring compounds that the Flavor and Extract

Manufacturers Association lists as “high priority,” i.e., they may pose a respiratory hazard in the workplace. Each e-cigarette was inserted into a sealed chamber attached to a lab-built device that drew air through the e-cigarette for eight seconds at a time with a resting period of 15 or 30 second between each draw. The air stream was then analyzed.

At least one of the three chemicals was detected in 47 of the 51 flavors tested. Diacetyl was detected above the laboratory limit of detection in 39 of the flavors tested. Acetoin and 2,3-pentanedione were detected in 46 and 23 and of the flavors, respectively.

“Since most of the health concerns about e-cigarettes have focused on nicotine, there is still much we do not know about e-cigarettes. In addition to containing varying levels of the addictive substance nicotine, they also contain other cancer-causing chemicals, such as formaldehyde, and as our study shows, flavoring chemicals that can cause lung damage,” said study co-author David Christiani, Elkan Blout Professor of Environmental Genetics.

Other Harvard Chan School authors included Skye Flanigan, Mallory LeBlanc, Jose Vallarino, Piers MacNaughton, and James Stewart.

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*Photo courtesy of [www.vaping360.com](http://www.vaping360.com).*