JUUL delivers substantially more nicotine than previous generation e-cigs and cigarettes: study

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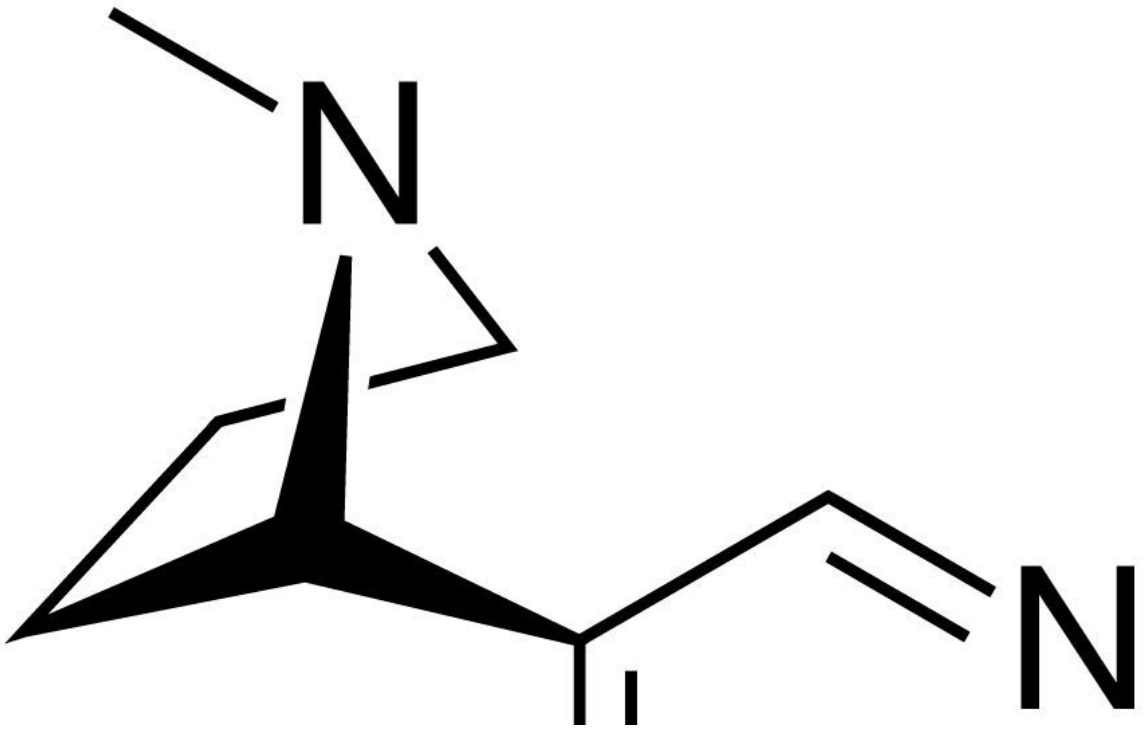

Nicotine, alternate molecular skeletal 2D rendering showing the 3D conformation of its ring at lowest energy in actual space. Credit: Public Domain

JUUL delivers substantially more nicotine to the blood per puff than cigarettes or previous-generation e-cigarettes (e-cigs) and impairs blood

vessel function comparable to cigarette smoke, according to a new study by researchers at UC San Francisco.

The study, which appears online Jan. 4, 2020, in *Tobacco Regulatory Science*, found that nicotine concentrations were five to eight times higher in rodents that were exposed to JUUL versus other tobacco products. The work also supports an earlier finding by the same researchers of harm to blood vessels from brief exposures to both direct and secondhand smoke from cigarettes, little cigars and combustible marijuana, and to aerosol from IQOS "heat-not-burn" tobacco products.

JUUL and earlier generation e-cigs are promoted as being less hazardous than cigarettes. Since 2016, there has been a dramatic increase in youth e-cig use, with JUUL devices particularly effective at recruiting teenagers to begin nicotine usage. A recent study found 27.5 percent of high school students and 10.5 percent of eighth graders currently use e-cigs, with more than half of both groups using JUUL as their preferred choice.

A caveat of this study is that it measured the impact of equal numbers of puffs of all products, whereas adult former cigarette smokers may stop their vaping session when they reach the level of nicotine they normally ingest, said senior author Matthew Springer, Ph.D., professor of cardiology at UCSF and member of the UCSF Center for Tobacco Research and Education.

"However, adolescent non-smokers who are not familiar with the effects of nicotine may be more likely to chase higher levels of the drug's effects," Springer said. "The ease of over-consuming nicotine with JUUL makes this likely, especially in light of reports of teenagers binging on JUUL to the point of rapid addiction and behavioral consequences."

As with earlier-generation e-cigs, the liquid in JUUL pods is composed of vegetable glycerin and propylene glycol, along with flavors and nicotine. But while the freebase nicotine used in earlier generations limits the amount comfortably inhaled, JUUL has introduced acidified nicotine salts, which are easier to inhale and deliver nicotine at substantially higher concentrations.

In the *Tobacco Regulatory Science* study, eight rats were exposed to 10 cycles of two-second inhalation over a five-minute period, with one of four different substances: JUUL, an e-cigarette with freebase nicotine e-liquid, cigarettes or clean air. The researchers collected blood samples 20 minutes after exposure and measured blood vessel impact through a process known as flow mediated dilation. This approach, which is a validated measurement of human cardiovascular health, has been shown in rodents to yield pharmacological and biophysical effects similar to humans, Springer said.

The research found that blood nicotine concentrations in the JUUL group (136.4 ng/ml) were eight times higher than e-cigs group (17.1 ng/ml) and 5.2 times higher than cigarettes (26.1 ng/ml).

However, while Springer and his colleagues found that aerosol or smoke from JUUL caused greater blood vessel impairment than either of the other nicotine sources, the differences in the extent of impairment between the sources themselves was deemed statistically insignificant.

"The comparison of cardiovascular health effects of JUUL use with those of previous generation e-cigs and of combusted cigarettes is an important issue for policymakers, including the FDA and comparable bodies outside the United States," Springer said. "Our findings show that the adverse effect of cigarettes on vascular endothelial function, which has been a known consequence of cigarette smoking since the 1990s, is not prevented by using JUUL."

More information: Poonam Rao et al, JUUL and Combusted Cigarettes Comparably Impair Endothelial Function, *Tobacco Regulatory Science* (2020). DOI: 10.18001/TRS.6.1.4