



E-Cigarette Flavors: **An Overview of the Evidence of** **Their Impact on Use and Health**

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Overview

- Most e-cigarettes are flavored*
 - More than 7,000 e-liquid flavors (Zhu et al., 2014)
 - Distinguish traditional tobacco flavors from others flavors
- Flavored e-cigarettes have come under intense national scrutiny

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Durbin To E-Cigarette Industry: Gummy Bear-Flavored Liquid Nicotine Helps Adults Quit Smoking? Prove It

Bipartisan Bill Addresses Sharp Increase In Number Of Kids Using E-Cigarettes

- Why?
 - Flavors linked to appeal, experimentation, initiation, and maintenance of youth tobacco use (incl. e-cigarettes)
 - Flavor additives in e-cigarettes may have health consequences
 - Currently, FDA enforcement discretion allows flavored e-cigarettes

E-cigarette Flavors and Youth

- E-cigarettes are marketed with youth-appealing flavors ([SGR, 2016](#))



- Appealing flavors are a strong attraction to e-cigarettes (Ambrose et al., 2015; Harrell et al., 2017; Pepper et al., 2016; Shang et al., 2017; Tsai et al., 2018)
 - Menthol, candy, or fruit flavors → greater interest
 - >98% use flavored e-cigarettes; 82% used because of flavors
 - Most: Fruit (76%) & Candy/Dessert (57%); Least: Tobacco (13%)
- Flavor descriptors may affect perceptions of e-cigarettes (Pepper et al., 2016; Czoli et al., 2015)

E-cigarette Flavors and Adults

- Flavors make e-cigarettes appealing also to adults (Nonnemaker et al. 2016; Harrell et al., 2017; Czoli et al. 2016; Pesko et al., 2016; Buckell et al., 2018)
- Smokers equally or more likely to initiate e-cigarette use with tobacco flavor as with non-tobacco flavors
 - but tend to switch to non-tobacco flavors (Farsalinos et al., 2013; Harrell et al., 2017); Former smokers more likely to initiate with fruit flavors
 - Fruit most popular flavor category among adults, but varies by age:
 - Younger adults: Fruit (74%); Candy/Dessert (50%); ... Tobacco (1%)
 - Older adults: Fruit (47%); Menthol (32%); ... Tobacco (13%)
- Preference for flavors linked to perceptions of lower harm (Czoli et al.)
- May affect smoking reduction and quitting in smokers using e-cigarettes to quit (Weaver et al., 2018; Smith et al., 2016; Chen, 2018)

E-cigarette Flavors and Health

- Many flavors are Generally Recognized As Safe (GRAS), but
 - in food products at levels of intended use.
 - When aerosolized and inhaled, may have adverse health effects
- More than 140 volatile flavoring components identified (Hutzler et al., 2014)
 - Cinnamaldehyde (cinnamon-, tobacco-, sweet-, and fruit-flavored e-liquids) (Behar, 2016)
 - “even at low concentrations, cinnamaldehyde in e-cigarette products is cytotoxic and genotoxic and adversely affects cell processes and survival... may impair homeostasis in the respiratory system.” ([NASEM, 2018](#))
- Benzaldehyde, diacetyl, acetylpropionyl, acetoin...



E-cigarette Flavors and Health (2)

- May affect nicotine absorption (Walele et al. 2016, Helen et al. 2017)
- May increase the reinforcing effects of nicotine & increase dependence (Ahijevych & Garrett, 2010; Garten & Falkner, 2004)
 - Sweet-flavored e-liquids → more rewarding (Audrain-McGovern et al., 2016) and higher abuse liability rating vs. non-sweet and flavorless (Goldstein et al., 2016)
- Challenges
 - Many flavoring additives have not been evaluated for toxicity in e-cigarettes
 - Issues of generalization to humans and across devices and use patterns
 - Effects on long-term disease and mortality risk unknown

Policy Landscape & E-cigarette Flavors

- Federal
 - *March 2018* – FDA issued an ANPRM on role of flavors in:
 - Youth experimentation and use
 - Helping smokers switch to potentially less harmful tobacco
 - *May - Nov 2018* – FDA sent warning letters to 18 companies for selling e-liquids resembling kid-friendly food products (cereal, candy, PB&J, juice, etc.)
 - *July 2018* – Sen. Durbin & Murkowski introduced SAFE Kids act
 - *November 2018* – FDA announced revisiting compliance policy for flavored e-cigarettes (other than tobacco, mint, menthol) if not
 - Sold in age-restricted, in-person locations, or
 - Online outlets with heightened age-verification practices
- Local
 - Several localities have prohibited sale of flavored tobacco, including e-cigarettes

E-cigarette Flavors & Regulatory Challenges

- Balancing concerns of youth use with harm reduction for adult smokers
- Complexity of flavors
 - 7000+ flavors – but theoretically limitless
 - Chemical compounds vs. sensory experience vs. marketing/packaging
- Avoiding unintended consequences
- Policy Resource:
 - [Tips & Tools Regulating Flavored Tobacco – Public Health Law Center](#)