

# Reducing attractiveness of e-liquids: proposal for a restrictive list of tobacco-related flavorings

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## Summary

- The Dutch government decided to ban all e-liquid flavors other than tobacco, by only allowing flavoring additives that impart a tobacco flavor.
- We compiled a restrictive list of 16 flavorings that meet this requirement.
- Implementing this restrictive list in legislation will likely discourage e-cigarette use among youth, but also make e-cigarettes less attractive as a smoking cessation aid.

## Background

Electronic cigarettes are addictive and harmful, and flavor is a key factor determining their abuse liability. As both adult smokers and young non-smokers like sweet and fruity flavors in particular, e-cigarette use can be discouraged by banning such flavors. In June 2020, the Dutch Government decided to only allow tobacco flavors in e-liquids, to protect young people against the harmful effects of e-cigarettes, whilst maintaining e-cigarettes as a tool for smoking cessation. The flavor ban will be based on a restrictive list of flavor-determining additives in e-cigarettes. We here propose a restrictive list of allowed flavorings that will only enable the production of e-liquids with a non-sweet tobacco flavor.

## Methods

We used e-liquid data notified by manufacturers via the European Common Entry Gate system as active on the Dutch market on 20 June 2020, before the ban was announced. This yielded a data set for 28,556 e-liquids that contained a total of 1,981 ingredients. We classified all e-liquids into flavor categories and identified 3,366 e-liquids marketed as having a tobacco flavor. These contained a total of 503 different flavorings, offering a wide range of flavors. Next, we applied selection criteria and we excluded:

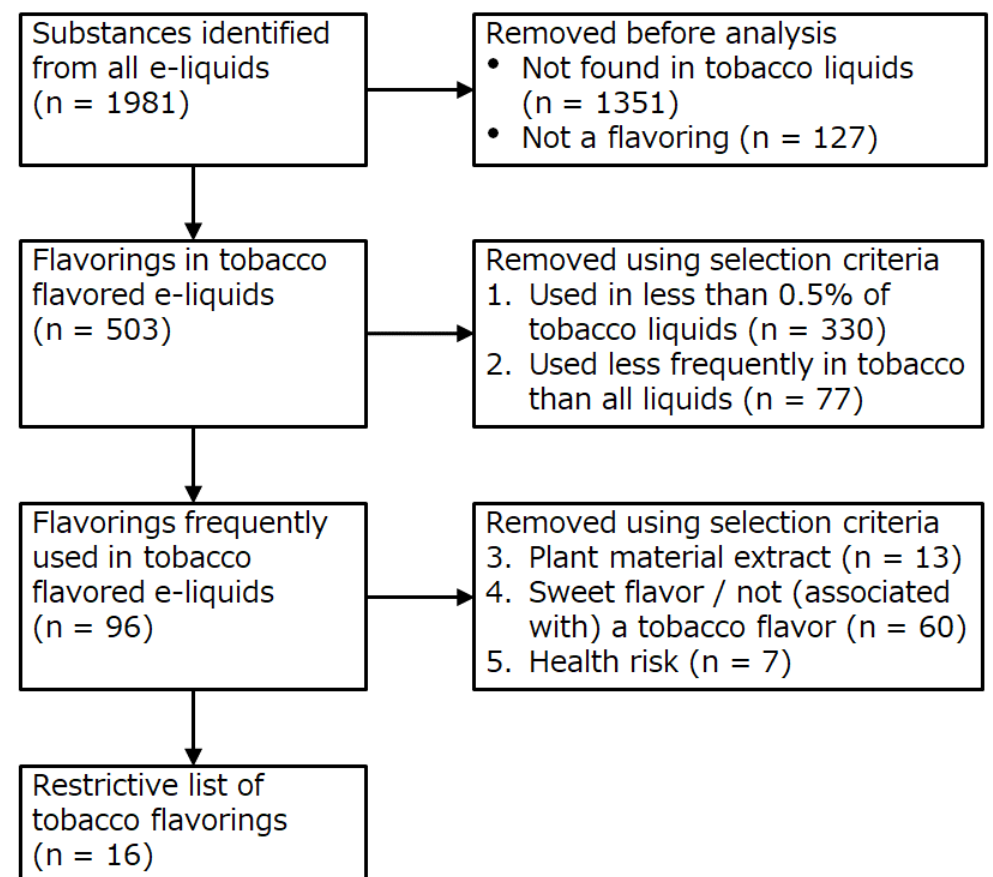
- 330 flavorings used in < 0.5% of e-liquids, because such rarely used flavorings are not expected to be essential for creating a tobacco flavor
- 77 flavorings used less frequently in tobacco than in all e-liquids, because these flavorings are mainly used to make non-tobacco flavored e-liquids
- 13 plant extracts, because these have a variable composition which hinders analytical monitoring if an e-liquid is compliant with a list of allowed flavorings
- 60 sweet flavorings or flavorings not associated with tobacco flavor, so that only flavorings with a tobacco-related flavor remain
- 7 flavorings with hazardous properties.

## Results and discussion

The described approach (summarized in Figure 1) resulted in a final list of 16 flavorings (Table 1).

Implementing this restrictive list in legislation will likely discourage e-cigarette use among youth, but also make e-cigarettes less attractive as smoking cessation aid. Regulators should also consider that users may add non-tobacco flavorings not marketed for use in e-liquids as alternative. After implementation, it would be useful to evaluate whether this proposed list achieves the objective of there being only tobacco-flavored e-liquids on the market.

**Figure 1.** Flow chart for the stepwise application of selection criteria to obtain a proposed list of allowed flavorings.



**Table 1.** Proposal for a list of allowed flavorings in e-cigarette e-liquids.

Flavoring name	Flavor & odor description
beta-Damascone	Blackcurrant, plum, rose, honey, tobacco
(E)-beta-Damascone	Blackcurrant, plum, rose, honey, tobacco
(Z)-beta-Damascone	Blackcurrant, plum, rose, honey, tobacco
Damascenone	Fruity-floral with apple-plum-raisin-prune, tea, rose, tobacco notes
(E)-beta-Damascenone	Fruity-floral with apple-plum-raisin-prune, tea, rose, tobacco notes
Keto-isophorone	Tobacco like, hay-straw, tea notes, honey
2-Hydroxy-3,5,5-trimethyl-2-cyclohexenone	Sweet, musty tea, caramellic, nutty, tobacco
3-Ethylpyridine	Strong tobacco, roasted, nutty, smoky
3-Acetylpyridine	Strong, burnt roasted, nutty, cigar tobacco
2,6-Dimethoxyphenol	Phenolic-woody-medicinal, tarry, spicy, smoky (bacon)
5-(Hydroxymethyl)-2-furfural	Herbaceous, winey, hay-like, tobacco
alpha-Angelica lactone	Sweet, bread, molasses, coumarin, tobacco, nut
Isovaleric acid	Very sour, 'sweaty', cheesy, fruity
(-)-Caryophyllene oxide	Dry, woody, faint cedar, tobacco
Ambroxide	Intense velvety ambergris notes
(3aR)-(+)-Sclareolide	Cedary, woody

## Additional remarks

The authors declare that they have no conflict of interest.

This work is described in more detail in RIVM reports 2021-0074 and 2022-0050 (in Dutch).