German Federal Institute for Risk Assessment

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Flavouring substances in e-cigarettes: updated assessment of safrole, sucralose and menthol

→ Update of opinion 43/2021 issued 28 December 2021 "BfR opinion: Health risks from flavouring substances in e-cigarettes: more research is necessary". The assessment of the substances safrole, sucralose and menthol has been updated.

E-cigarette liquids, which are heated or vapourised during smoking, usually contain flavouring substances that give the inhaled vapour a certain taste. Compared to the smoke from tobacco cigarettes, the aerosols from e-cigarettes contain significantly fewer harmful substances, but they still pose a health risk to the respiratory tract because toxic substances can form when flavourings are heated and vapourised. In 2021, the German Federal Institute for Risk Assessment (BfR) assessed the data situation regarding the potential health risks posed by flavourings in electronic cigarette liquids. The BfR has now updated its assessment of three of the previously examined substances.

1 Subject of the assessment

In the present reassessment, the BfR examined whether there is new scientific evidence on the flavouring substances menthol, safrole and sucralose with regard to their use in e-cigarettes.

2 Results

1. Safrole

The substance 5-allylbenzo[1,3]dioxole (safrole), CAS No. 94-59-7 is harmonised under the CLP Regulation as a category 2 mutagenic substance and a category 1B carcinogenic substance and is therefore prohibited in e-cigarettes and refill containers in accordance with Annex 2 point 4. a) of the German Tobacco Products Ordinance.

2. Sucralose

In its 2019 opinion on the sweetener sucralose in foodstuffs, the BfR already pointed out that the substance decomposes at temperatures above 120°C and forms harmful chlorine compounds such as chloropropanoles [1].

There are now also studies that show decomposition in the liquid when heated in an e-cigarette [2,3]. The formation of chloropropanole derivatives was shown here, for example. In the study, the number of puffs had a greater influence on the formation of chlorinated components than the influence of temperature at operating temperatures of over 200 °C. In another study, it was found that the formation of aldehydes such as propanal, acetaldehyde, glycolaldehyde and acrolein as well as formaldehyde hemiacetals, which can release formaldehyde, increases when an e-liquid containing sucralose (0.24% w/w or more) is vaporised [4].

It should be noted that in one study, the tested concentrations of sucralose (1–7% w/w) were higher than the concentrations in commercially available liquids of 0.1–0.5% w/w [5]. However, sucralose is also used by consumers themselves as a "do-it-yourself" sweetener.

3. Menthol

Menthol is a frequently used flavour in liquids. It not only occurs in menthol-flavoured liquids, but is also contained in low concentrations in many other commercially available liquids to round off the flavour. Due to activation of thermosensitive receptors, menthol has a cooling effect in the region of the tongue and oral cavity[6-8]. It also has a local anaesthetic effect, as it blocks pain receptors [7]. The effects can alleviate irritation in the oral cavity and throat. In animal experiments, for example, reduced defence reactions against irritating components of tobacco smoke were found, which were mediated by the cold receptor TRPM8 [9]. Activation of the TRPM8 receptor is the central physiological mechanism of action [10]. In sensitive people, menthol can also suppress the cough stimulus triggered by certain chemicals such as capsaicin [11].

A study from 2016 shows that menthol alleviates the irritating sensory effects of liquids with high nicotine content [12]. Although there is currently a lack of studies that would prove increased inhalation or nicotine uptake when vaping e-cigarettes containing menthol, the existing data suggests that menthol and other TRPM8-activating substances make it easier to start vaping, even with e-cigarettes with high nicotine levels.

There is also current evidence that menthol in liquids leads to an increased release of micro- and submicron particles when consuming e-cigarettes. This is associated with poorer lung function in smokers who use tobacco and e-cigarettes at the same time (dual use) [13].

Menthol is also contained in medicines and numerous other products that are considered to be beneficial to health. There are a large number of menthol-containing medicines on the market that are recommended for inhalative treatment of colds. These products claim to have properties such as eliciting relaxation, facilitating coughing, and providing relief. Thus, the impression that menthol has health benefits may also be created when using liquids containing menthol.

Despite current studies on reduced health hazards of e-cigarettes compared to conventional tobacco cigarettes and the described assistance in quitting smoking [14,15], the protection of minors is an important aspect, especially with regard to fruity flavourings and those with a menthol taste. There is evidence that menthol,

even in very low concentrations, can increase the attractiveness of e-cigarettes to adolescents [16]. For example, a study from 2022 shows widespread use of menthol and fruit-flavoured e-cigarettes among adolescents and young adults in the United States [17].

This should be viewed particularly critically, as the increased attractiveness could encourage continued consumption and the transition to higher, addictive nicotine levels. This is particularly true in combination with higher menthol concentrations, as found in commercial liquids.

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Further information on e-cigarettes on the BfR website

FAQ: E-cigarettes – anything but harmless
https://www.bfr.bund.de/en/release/e-cigarettes-anything-but-harmless/

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The German Federal Institute for Risk Assessment (BfR) is a scientifically independent institution within the portfolio of the Federal Ministry of Agriculture, Food and Regional Identity (BMLEH) in Germany. The BfR advises the Federal Government and the States ('Laender') on questions of food, chemicals and product safety. The BfR conducts independent research on topics that are closely linked to its assessment tasks.

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