

Open questions on the risk posed by vitamin E acetate in e-cigarettes

Communication 007/2020 from the BfR of 28th of January 2020

In the United States, vitamin E acetate has been linked to a number of serious lung injuries and deaths from the use of e-vaping products. However, it has not yet been proven that this substance is actually, solely or to some extent, responsible for the diseases. So far, data on the inhalation of this substance is limited and sometimes contradictory.

However, due to its properties, it seems plausible that inhaling high concentrations of vitamin E acetate could cause lung diseases. Presumably, the substance accumulates in the alveoli, which would hinder the absorption of oxygen. Tissue damage and inflammation may also result.

Many affected people in the United States appear to have consumed products containing THC oils. In the United States, vitamin E acetate is often used as a diluent, especially in products that are offered on the black market. Vitamin E acetate is similar in consistency and colour to THC oils. Therefore, it can be used to alter the products mimicking higher concentrations of THC oil. Initial analyses by US authorities have shown surprisingly high concentrations of vitamin E acetate in cartridges containing THC. Concentrations between 31 and 88% were found in the US state of Utah. Such concentrations appear sufficient to severely damage the lungs and impair their function.

It remains an open question whether vitamin E acetate is also used in other e-liquids. The BfR currently has no concrete findings. It is also unclear up to which concentrations of vitamin E acetate conventional vaporisers / e-cigarettes would continue to work.

In Germany, nicotine-containing e-liquids must not contain any vitamins according to the tobacco regulations. Therefore, when using legally compliant nicotine-containing products, it is unlikely that consumers will be exposed to e-liquids with a high concentration of vitamin E acetate.

By contrast, nicotine-free e-liquids are not subject to tobacco law, therefore these restrictions do not apply to them. However, manufacturers and importers can voluntarily notify these products via the EU-CEG portal (EU Common Entry Gate). To the best of the BfR's knowledge, no notification of liquids containing the ingredient vitamin E acetate has so far been issued in the EU. In principle, however, both nicotine-containing and nicotine-free e-cigarettes can impair health.

Further information on possible risks when using e-cigarettes

Press release - "Vaping": The BfR advises against mixing e-liquids yourself

https://www.bfr.bund.de/en/press_information/2019/39/vaping_the_bfr_advises_against_self_mixing_e_liquids-242872.html

Occurrence of vitamin E acetate and effects on the lungs

Non-acetylated α -tocopherol ("vitamin E") can be used to purify citrus oils for e-liquids. Citrus oils are essential oils that are obtained from the peel of citrus fruits by cold pressing or by steam distillation. According to manufacturer information, vitamin E is used in pre-production as an antioxidant to stabilise high-quality ingredients, especially photosensitive citrus oils. Even with the small amounts of essential oils, traces of vitamin E may still be contained in the final e-liquids. Inhalation toxicological risks are, however, not to be expected with very low vitamin E concentrations (<0.1%).

In the United States, acetylated α -tocopherol (α -tocopheryl acetate, "vitamin E acetate") has been associated with a number of cases of severe lung damage after vaporiser use. Little is known about the inhalation toxicological effects of vitamin E acetate. Usage as a tobacco additive was discussed a few years ago due to its antioxidant properties being expected to reduce the toxicity of tobacco smoke. Previously in 2003, the BfR spoke out against the use of vitamin E acetate in tobacco productsⁱ because no health-promoting effect was discernible and the safety of long-term use smoking vitamin E acetate was not proven.

Currently, there is only a limited amount, sometimes contradictory, toxicological data on the inhalation of vitamin E acetate. Due to its amphiphilic (both water and fat soluble) properties, vitamin E acetate could accumulate on the fluid film of the alveoli and in the membranes of the lung epithelial cells. Gas exchange impairment, tissue damage and inflammation reactions could occur at correspondingly high concentrations.

Current incidents in the United States are associated with very high inhalation exposure to this substance. Up until now, vitamin E acetate has been used to dilute self-mixed THC-containing vaping products, which are mostly available in pre-filled cartridges apparently. Analyses of THC-containing cartridges in Utah by the American Food and Drug Administration (FDA) and other US laboratories showed surprisingly high vitamin E acetate concentrations of 31% - 88%. Based on the current state of knowledge, it can be assumed that such high doses can trigger serious respiratory diseases. In contrast, the THC concentrations (14% - 76%) in these samples were significantly below the advertised valuesⁱⁱ.

Occurrence of vitamin E acetate in e-liquids

According to the current state of knowledge, vitamin E acetate mainly occurs in THC-containing products. It is currently unclear whether the substance is also used in other e-liquids. Evaluation of the cases in the USA is still at the beginning. However, vitamin E acetate has been detected in the lung fluid of those affected. Also, which doses or forms of application lead to respiratory diseases is still unclear. Other factors may play a role. The fungicide myclobutanil, which is used illegally in permissible cannabis cultivation, has been discussed as another possible cause. Inferior vitamin E acetate could also be contaminated with hydroquinone or lipids.

The consumption of THC oil using e-cigarettes requires some technical modifications. THC oil is a complex mixture of organic compounds which does not contain fatty oils. It is obtained from the female flowers and leaves of the cannabis plant by steam distillation or butane gas extraction. Vitamin E acetate is similar in consistency and colour to THC oils. When mixed with THC oils, the substance can mimic higher concentrations of THC oil, which could be considered as product manipulation. However, vitamin E acetate may also be a matrix to consume other herbal distillates / extracts.

The technical applications of conventional e-cigarettes, which typically nebulise liquids containing glycerol / propylene glycol, are limited. Thickeners are usually not required. It would be conceivable to use vitamin E acetate as an emulsifier, for example in order to emulsify lipophilic ingredients in glycerol / propylene glycol liquids. No specific findings are currently available. It is also unclear up to which concentrations of vitamin E acetate conventional vapourisers / e-cigarettes would continue to work.

Vitamin E acetate in e-liquids in Germany

In Germany, it is unlikely that legally available nicotine-containing products contain vitamin E acetate. Liquids containing nicotine are subject to tobacco law and may not contain any vitamins, among other things. E-liquids containing nicotine are reported by the manufacturers and distributors via the EU-wide uniform EU-CEG portal (EU-Common Entry Gate). This communication is, amongst other things, intended for the sharing of toxicological data on ingredients and emissions. Similar to food, e-liquids are monitored by the food monitoring authorities of the German federal states ("Bundeslaender").

In contrast, nicotine-free e-liquids are not subject to tobacco law. However, like all other e-liquids, they must also meet the requirements of the Product Safety Act and chemical laws. The manufacturers, importers, and retailers of these products are responsible for compliance with these legal regulations. Manufacturers and importers may report nicotine-free e-liquids in the EU-CEG on a voluntary basis. To the best of the BfR's knowledge, no notification of nicotine-free liquids containing the ingredient vitamin E acetate has been issued in the EU so far.

It is also important to differentiate between the ingredients vitamin E and vitamin E acetate (see above). Vitamin E has been reported as an ingredient in individual e-liquids. It is not known whether these products are actually on the market or have already been restricted. This is the responsibility of the regional authorities of the German federal states ("Bundeslaender").

Further information on the BfR website on the subject of e-cigarettes

A-Z Index "Electronic Cigarette"

https://www.bfr.bund.de/en/a-z_index/electronic_cigarette-130005.html



BfR "Opinions app"

About the BfR

The German Federal Institute for Risk Assessment (BfR) is a scientifically independent institution within the portfolio of the Federal Ministry of Food and Agriculture (BMEL) in Germany. It advises the German federal government and German federal states ("Laender") on ques-

tions of food, chemical and product safety. The BfR conducts its own research on topics that are closely linked to its assessment tasks.

This text version is a translation of the original German text which is the only legally binding version.

ⁱ https://mobil.bfr.bund.de/cm/343/vitamin_e_in_zigaretten.pdf

ⁱⁱ Lewis et al., 2019. E-cigarette use, or vaping, practices and characteristics among persons with associated lung injury – Utah, April-October 2019. MMWR 68: 953-956.