Acute human lung cell toxicity of some selected flavouring chemicals after simulation of vaping

Peter C. Dartsch[1], Oliver Okle[2], Thomas Alexander Mrva[3]

[1]Dartsch Scientific GmbH, Germany; [2]hjs consulting, Germany; [3]Happy People GmbH, Germany

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Introduction

In contrast to cigarette smoking, the vapour of e-cigarettes is not the result of a combustion process. However, the risks of e-cigarette use are uncertain which is due to the limited amount of scientific data regarding their health effects related to the variability of vaporisers, e-liquid ingredients and their quality (Dawkins and Corcoran 2014; Farsalinos and Polosa 2014). There are also limited amounts of studies looking on the *in vitro* toxicity profile of e-liquids and e-cigarettes by using cultured cells of the lung (Misra et al. 2014). Flavouring chemicals in general can be easily inhaled because they are very volatile substances that readily evaporate from liquid forms into the air, a characteristic feature that is amplified by application of heat as usual for e-cigarettes.

Here, we present data on the acute human lung cell toxicity of some selected flavouring chemicals after simulation of vaping.

Materials and methods

The investigations were done with the following 7 chemicals: Diacetyl (butane-2,3-dione), triacetin (1,2,3-triacetoxypropane), cinnamaldehyde, vanillin (4-hydroxy-3-methoxybenzaldehyd), acetoin (3-hydroxybutanone), benzaldehyde, and 2,3-pentane-dione (acetylproprionyl). The chemicals were used as 2 % solutions dissolved in a basic liquid of 50 % propylene glycol, 40 % vegetable glycerol and 10 % water without addition of nicotine. Liquids were transferred to a specially designed vaping apparatus and 20 puffs with a duration of 4-5 seconds and a pause of 10 seconds between two puffs were applied to the liquids (Figure 1). A common e-cigarette was used (eGrip OLED from Joyetech with a vaporiser of 1.7 Ohm and 3.3 Volt = 6.5 Watt). The vapour was piped into 20 ml of HEPES-buffered cell culture medium.

After sterile filtration, the primary extract was added at different test concentrations to cultures of human lung cells (A-549) with a seeding density of 10,000 cells/well in 96 well-plates. After 24 hours cell vitality was measured enzymatically by cleavage of XTT by the activity of mitochondrial dehydrogenases.

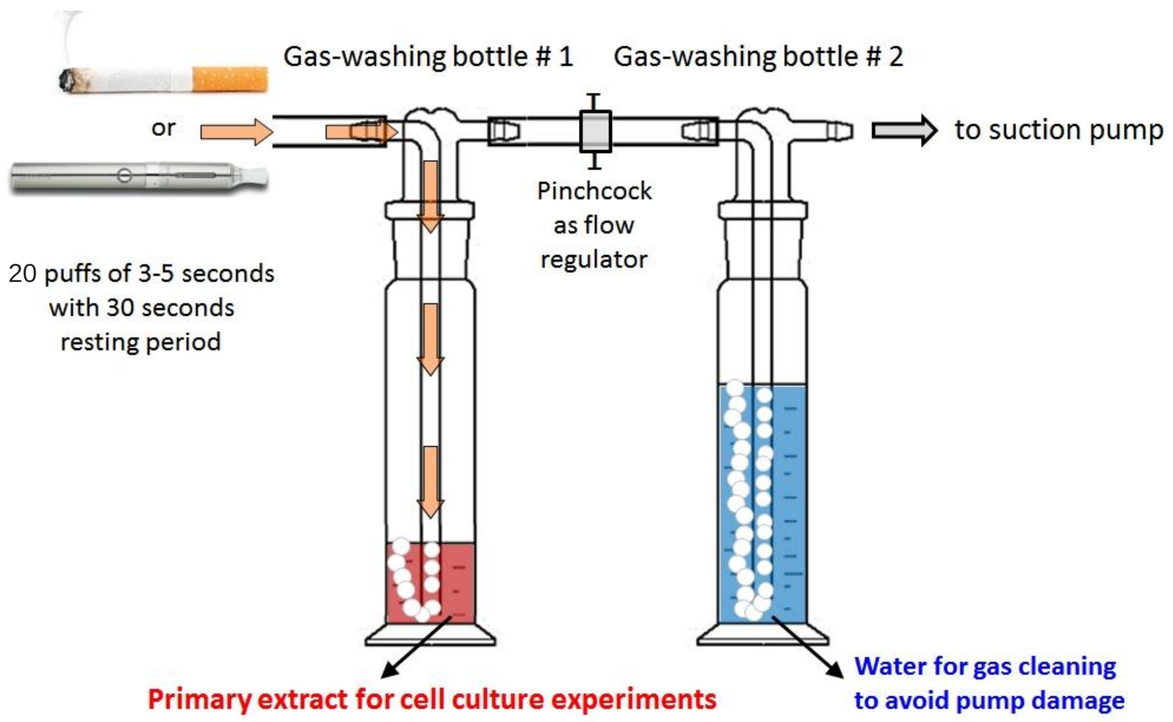

Figure 1: Experimental setup for simulation of cigarette smoking or vaping. The suction pump on the right generates an adjustable underpressure which aspirates the smoke or vapour and bubbles it into the culture medium in the left gas-washing bottle # 1. This yields the primary extract.

Results and conclusions

The data of acute cytotoxicity (Figure 2) clearly show that both aldehydes (cinnamaldehyde and benzaldehyde) as very reactive compounds had the strongest acute toxic effect followed by both diketones (diacetyl and 2,3-pentanedione), vanillin and acetoin. Triacetin had no acute toxic effect at all which confirms its significant value as a food and pharmaceutical additive (E1518).

The data clearly demonstrate that an acute toxic effect can occur in specific flavouring chemicals even at a moderate performance of the e-cigarette. Moreover, only assessment of acute toxicity seems to be not sufficient; an additional test on mutagenicity should be considered.

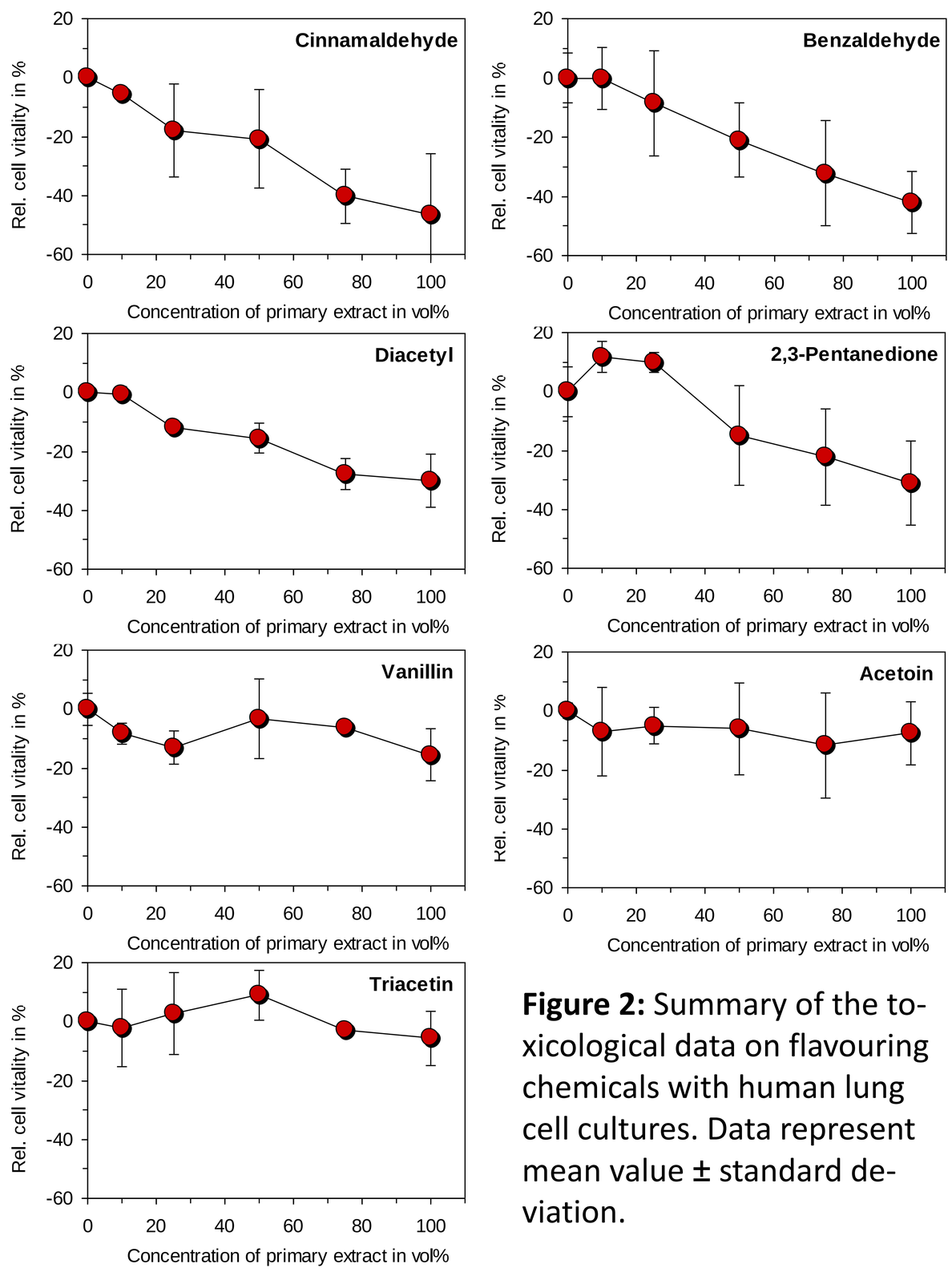

Figure 2: Summary of the toxicological data on flavouring chemicals with human lung cell cultures. Data represent mean value ± standard deviation.

References

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