Correlation of volatile carbonyl yields emitted by e-cigarettes with the temperature of the heating coil and the perceived sensorial quality of the generated vapours

Abstract:
E-liquids generally contain four main components: nicotine, flavours, water and carrier liquids. The carrier liquid dissolves flavours and nicotine and vaporises at a certain temperature on the atomizer of the e-cigarette. Propylene glycol and glycerol, the principal carriers used in e-liquids, undergo decomposition in contact with the atomizer heating-coil forming volatile carbonyls. Some of these, such as formaldehyde, acetaldehyde and acrolein, are of concern due to their adverse impact on human health when inhaled at sufficient concentrations. The aim of this study was to correlate the yield of volatile carbonyls emitted by e-cigarettes with the temperature of the heating coil. For this purpose, a popular commercial e-liquid was machine-vaped on a third generation e-cigarette which allowed the variation of the output wattage (5–25 W) and therefore the heat generated on the atomizer heating-coil. The temperature of the heating-coil was determined by infrared thermography and the vapour generated at each temperature underwent subjective sensorial quality evaluation by an experienced vaper. A steep increase in the generated carbonyls was observed when applying a battery-output of at least 15 W corresponding to 200–250°C on the heating coil. However, when considering concentrations in each inhaled puff, the short-term indoor air guideline value for formaldehyde was already exceeded at the lowest wattage of 5 W, which is the wattage applied in most 2nd generation e-cigarettes. Concentrations of acetaldehyde in each puff were several times below the short-term irritation threshold value for humans. Acrolein was only detected from 20 W upwards. The negative sensorial quality evaluation by the volunteering vaper of the vapour generated at 20 W demonstrated the unlikelihood that such a wattage would be realistically set by a vaper. This study highlights the importance to develop standardised testing methods for the assessment of carbonyl-emissions and emissions of other potentially harmful compounds from e-cigarettes. The wide variety and variability of products available on the market make the development of such methods and the associated standardised testing conditions particularly demanding.

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