Monitoring of exogenous compound kinetics in exhaled breath

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Introduction and Objectives

VOCs in breath are produced either by various biochemical processes within the body or as a result of external factors such as environmental exposure, lifestyle, diet, and/or therapeutic interventions. Real-time breath analysis is an advantageous analytical approach by which information about physiological changes over a short period of time can be obtained. Real-time analysis of human exhaled breath enables rapid monitoring of exposure-driven absorption of exogenous VOCs from the lungs into the bloodstream.

The aim of this study was to detect, confirm and monitor absorption of exogenous compounds originating from cigarette smoke and various inhalable products from the lungs into the bloodstream.

Methods

Human exhaled breath samples were analyzed with an Exhalion Super SESI coupled to a Q Exactive HF mass spectrometer.

The system measures CO_2 levels (%), pressure drop (mbar), exhalation flow rate (L/min), and total exhaled volume (L) in real-time.

Compounds present in exhaled breath are ionized by the Super SESI interface and detected by high-resolution MS.

Human volunteers exhaled before and after exposure to specific intervention, at a rate of one exhalation per minute. MS acquisition was performed in full-scan positive ionization mode by scanning *m/z* 50–600 at a resolution of 240,000. Putative compound identification was supported by the mass accuracy of the instrument (5 ppm tolerance) and further confirmed by tandem MS experiments using high-energy collisional dissociation (HCD).

Conclusions

- ✓ Exhalion Super SESI coupled to a Q Exactive HF MS system allows rapid monitoring of the absorption of exogenous compounds originating from cigarette smoke and/or aerosol from various inhalable products from the lungs into the bloodstream.
- ✓ Nicotine, one the main compound inhaled from smoking, showed a well-defined washing pattern in the lungs, where the intensity increased right after smoking and slowly decreased afterwards.
- ✓ Indole, known as an endogenous metabolite, showed a relatively flat profile depending on the type of exposure.
- ✓ Camphor, and pyridoxal—which were confirmed in a tested inhalable products—showed a similar washing pattern as nicotine.
- ✓ These results demonstrate the benefits of this device to study real-time exhaled breath samples.

Super SESI

Q Exactive HF Accurate Mass Detector

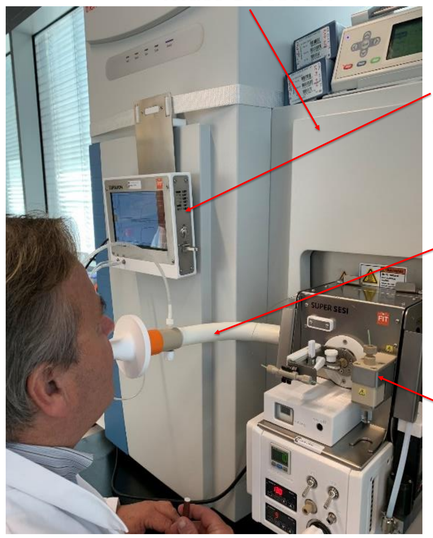

Figure 1. Exhaled breath experiment using the Super SESI interface coupled to a Q Exactive HF MS.

Results

CIGARETTE SMOKE

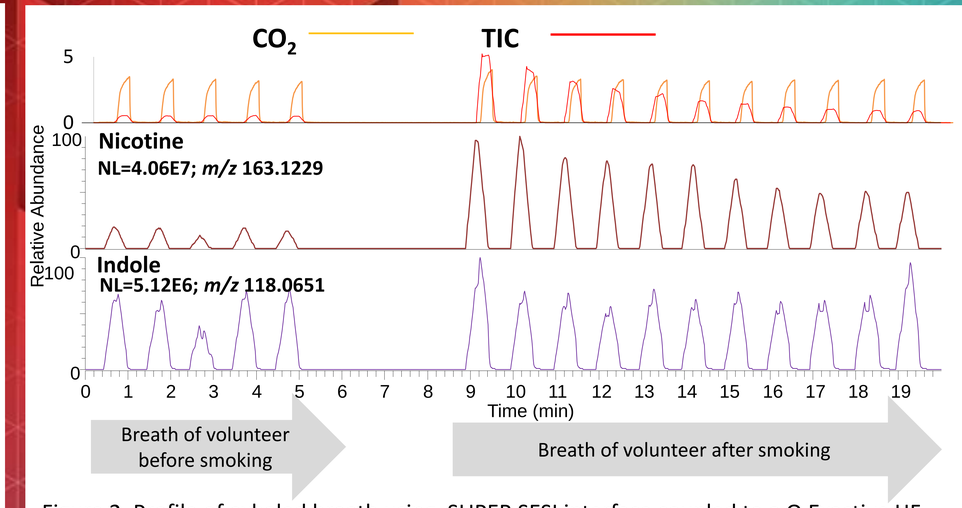

Figure 2. Profile of exhaled breath using SUPER SESI interface coupled to a Q Exactive HF MS before and after smoking.

INHALABLE PRODUCTS

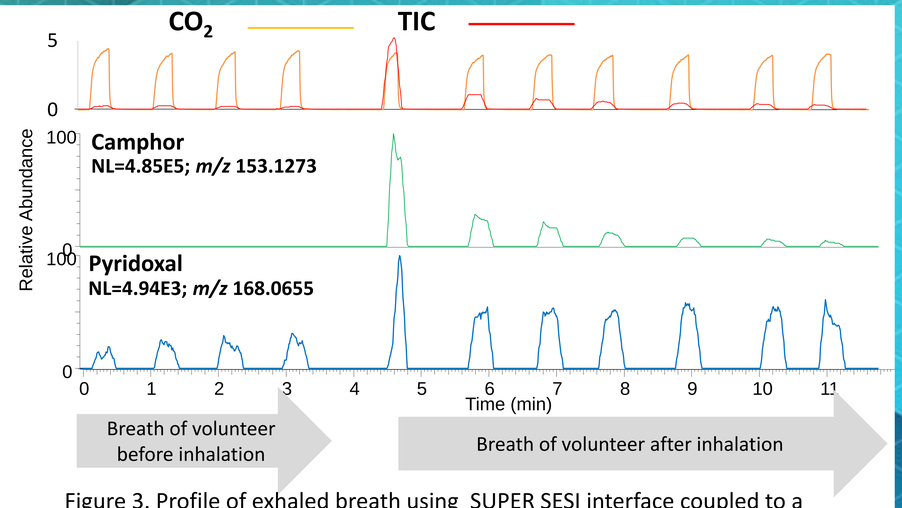

Figure 3. Profile of exhaled breath using SUPER SESI interface coupled to a Q Exactive HF MS before and after inhalation.

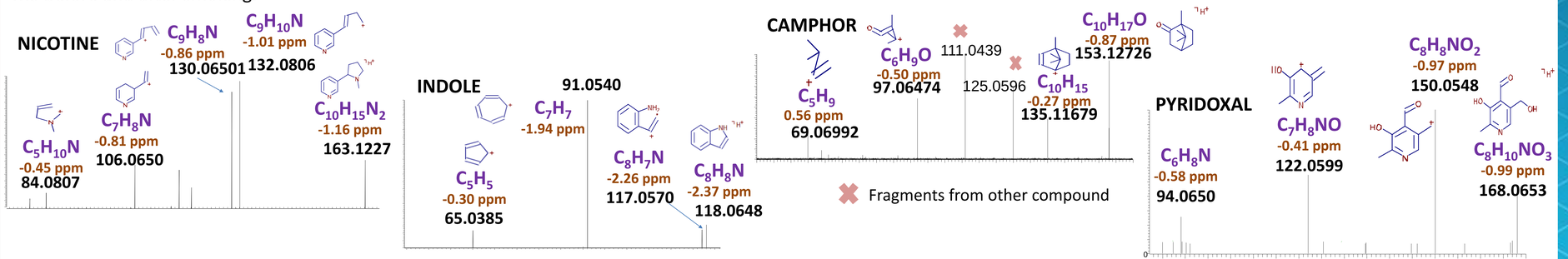

Figure 4. Experimental data of fragmentation of *m/z* 163.1229 (nicotine), *m/z* 118.0651 (indole), *m/z* 153.1273 (camphor), *m/z* 168.0655 (pyridoxal) from high-energy collisional dissociation (HCD).

References

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2. Gaugg *et al*. Expanding metabolite coverage of real-time breath analysis by coupling a universal secondary electrospray ionization source and high resolution mass spectrometry--a pilot study on tobacco smokers. *J. Breath Res.* 10, 1, 016010 (**2016**).
3. Zivkovic Semren *et al*. Monitoring of metabolite kinetics of tobacco users by real-time exhaled breath analysis. *Application note* (**2020**)

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