Imperial College London

The Association for Mass Spectrometry: Applications to the Clinical Lab

#4a

Impact of Oral Cleansing Strategies on Exhaled Volatile Organic Compound levels

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Background

The detection of volatile organic compounds (VOCs) within exhaled breath offers a non-invasive approach to detection and surveillance of human disease. Diagnostic breath testing is used in (i) health for small bowel bacterial overgrowth and H.pylori testing and (ii) law enforcement for monitoring of breath alcohol levels. Oral microbial fermentation produces volatile sulphur and fatty acid metabolites.[1-4] Knowledge about the contribution of VOCs from within the oral cavity may guide clearer recommendations regarding standardisation of breath collection methods in clinical practice.

Aims

To assess the impact of oral contamination and subsequent cleansing measures on levels of VOCs detected within exhaled breath.

Outcome: To provide a clearer understanding of the requirement for standardised practices in breath sampling.

Methods

Participant selection
- Healthy participants without known oral or systemic disease. Informed written consent taken.

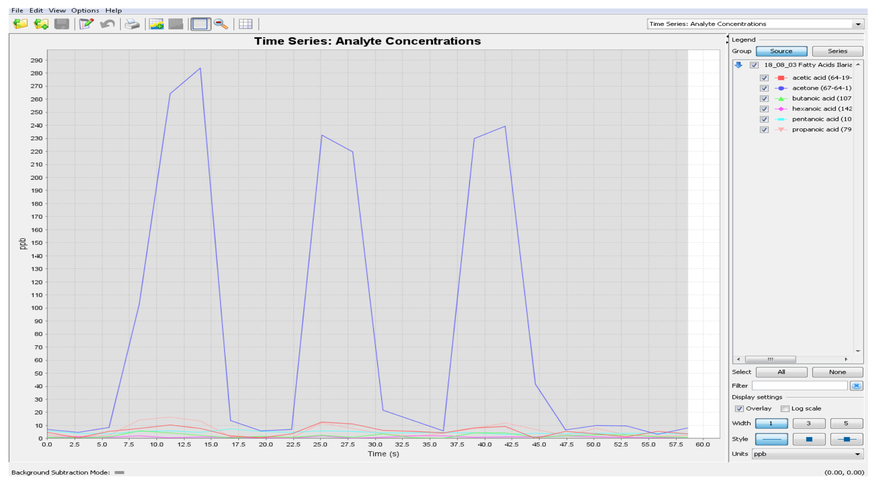
Breath sample collection
- Morning breath samples after 6 hours fasting. Protocol as shown below.
- Direct online analysis of target VOCs (short chain fatty acids, alcohols, aldehydes, phenol-alkanes, sulphur compounds).
- Exhale into the inlet of the SIFT-MS after tidal inhalation.

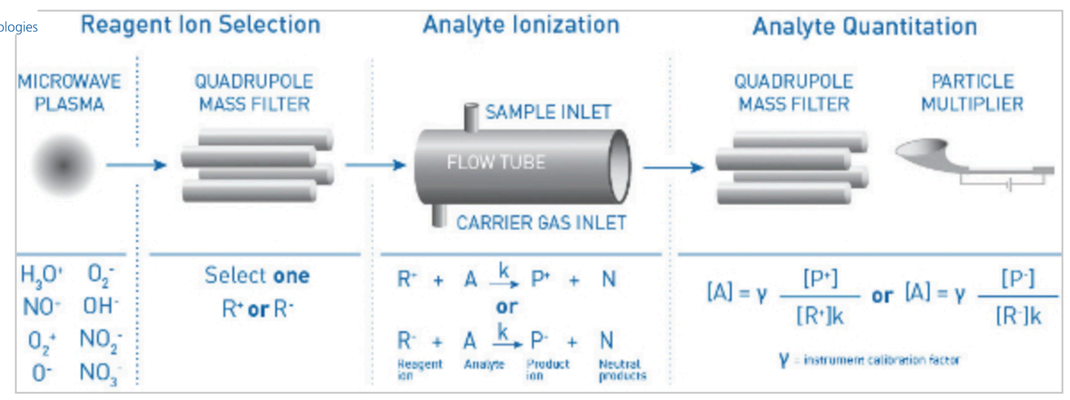
Protocol

Clear fluids only for 6 hours
↓
Standard nutrient challenge
Breath
↓
Oral rinse with water
Breath
↓
Oral rinse with salt water
Breath
↓
Brush teeth (Colgate toothpaste)
Breath
↓
Oral rinse with mouthwash (Colgate Plax)
Breath

Selected Ion Flow Tube – Mass Spectrometry (VoiceUltra 200, Syft Technologies, Anatune, UK)
- Real-time quantification of VOCs within the breath based on chemical ionisation occurring between selected reagent ions (H_3O^+, NO^+, O_2^+) and trace gases to create product ions.[5]
- Product ions are separated according to mass-to-charge ratio (*m/z*).
- Quality assurance – daily automated validation cycles, ambient operating temperature between 10-30°C.

Data analysis
- An average of 3 measurements over 60 seconds (ppbv).
- Friedmans statistical analysis. P<0.05 was considered statistically significant.





Results

Participants
- Ten healthy participants; 7 female; 28 ± 6 years

Acetone and Isoprene
- No significant variation during oral cleansing confirming their systemic origin.

Short chain fatty acids
- Butanoic and pentanoic acid declined after oral water rinse.
- Incremental decline of butanoic acid with each cleansing intervention.
- Minimal influence on acetic, hexanoic and propanoic acid.
- Reducing variability across subjects after each cleansing intervention.

Alcohols
- Ethanol levels fell significantly after oral water rinse and remained unchanged with further intervention. Consistent decline in variability.

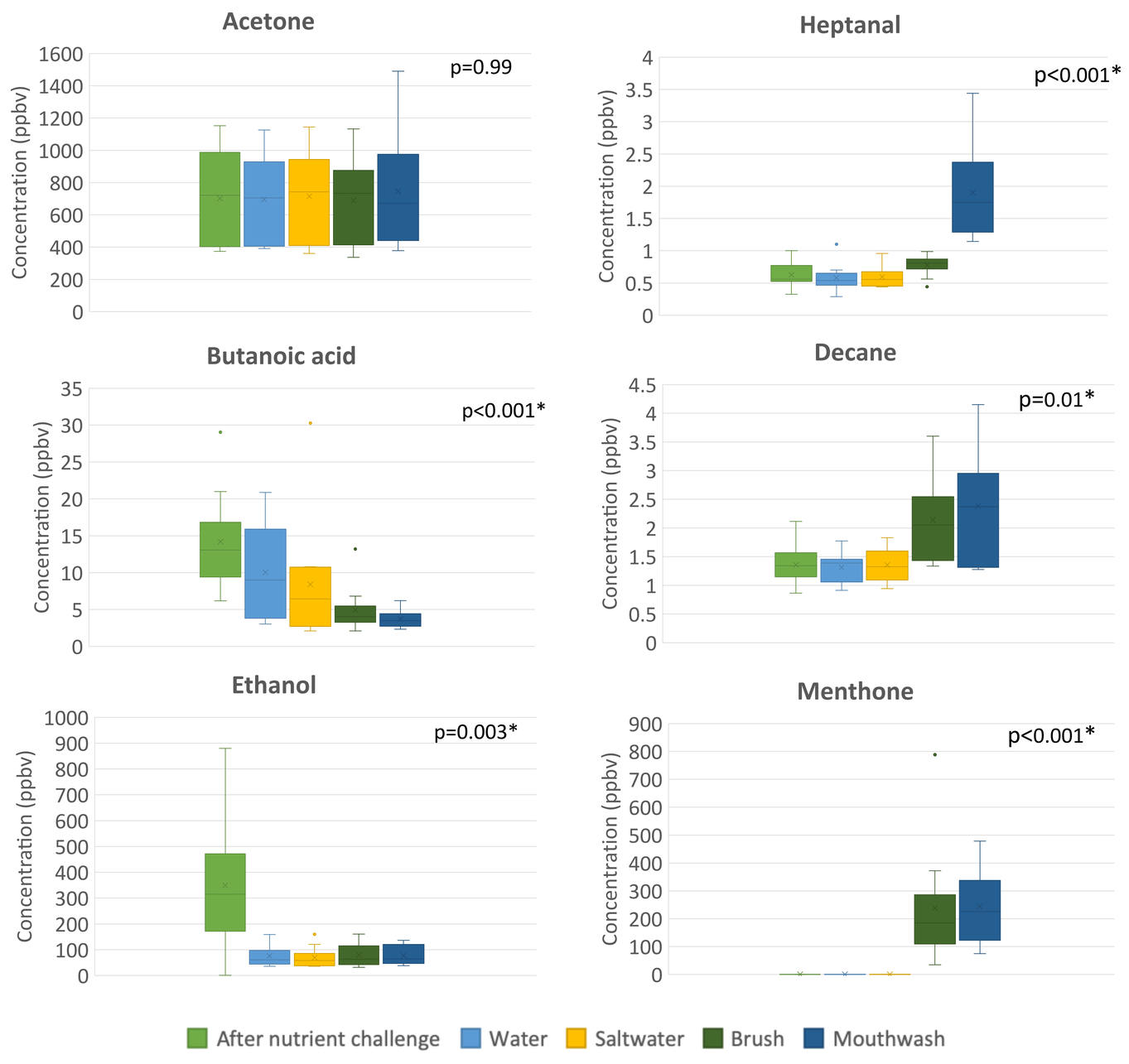
Aldehydes
- Propanal, hexanal, heptanal and nonanal levels were elevated after mouthwash use reflecting a potential contaminant.
- Acetaldehyde followed a similar pattern to the alcohol group declining after the oral rinse.

Phenol-alkanes
- Decane, dodecane and P-cresol were elevated after toothbrushing and mouthwash rinse.

Sulphur compounds
- No consistency of sulphur compound levels were observed among subjects.

Menthone
- Significant increase in levels after toothbrushing and mouthwash use reflecting the flavoured ingredient within the product.
- Note: menthone (*m/z* 154) overlaps with decanal product ion (*m/z* 155).

Figures *(right)*
Graphs demonstrating variation in volatile organic compound concentrations (ppbv) in response to successive oral cleansing measures.



Conclusion

Findings suggest that rinsing with water partially mitigates the effects of oral contamination and minimises variability of the baseline among subjects. Equally further attempts of oral decontamination using flavoured products may compromise results. This simple and inexpensive intervention may therefore serve as an important method of standardisation within breath research potentially reducing the requirement for prolonged fasting.

References

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