FOOD AND LIFESTYLE IMPACT ON THE EXHALED BREATH VOCs IN PROFESSIONAL ATHLETES

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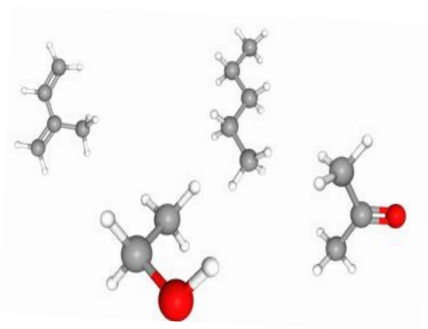
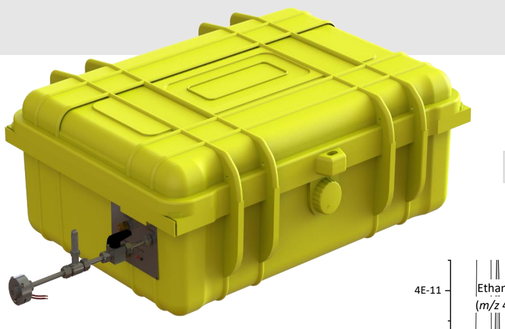
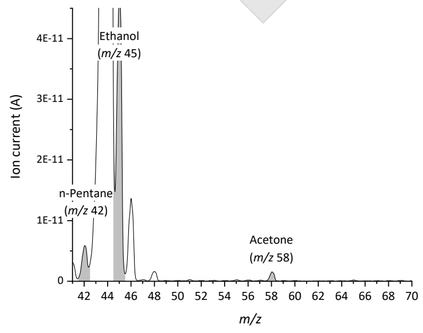
INTRODUCTION







Exhaled breath VOCs can instantly reflect some metabolic pathways.

Diet and lifestyle (physical activity, alcohol and tobacco consumption, pollution etc.) can affect levels of specific breath VOCs, such as acetone, ethanol, isoprene, and n-pentane.

Exhaled breath VOCs can be used as biomarkers for the improvement of a quality of life and general health.

To provide accurate diagnostics, an individual approach is required.

For wide individual screening, utilization of affordable solutions for on-site analysis is needed. These screening results would complement conventional diagnostic techniques for more efficient nutritional treatments.

MATERIALS AND METHODS

INSTRUMENTATION

Ion source: Electron impact (EI)
Mass analyzer: Single quadrupole
Mass scan range (m/z): 0-300
System dimensions (LxHxW): 616x220x433mm
Weight: 23Kg
Power consumption: <200 kWh

***Figure 1**. Portable mass spectrometer*

SAMPLE COLLECTION

Exhaled breath samples were collected in 1L Tedlar® bags from **44 professional athletes**, with informed consents.
Each participant provided two exhaled breath samples: before the meal – BM and 120 min after the meal – AM.

24 athletes from Greece and **20 athletes from Portugal**

AT 1 **AT 2**

Athletes were in a steady-state between two samplings

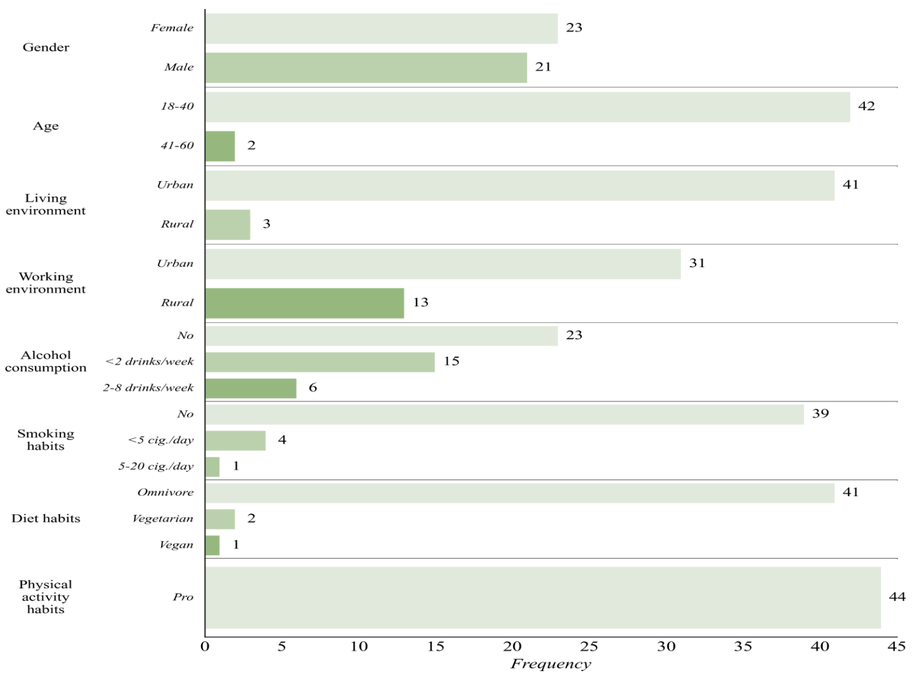
AT 1 meal		Energy (kcal)	CHO (g)	Protein (g)	Fat (g)
White Bread	2 slices, 80g	196	37.4	7.4	1.6
Strawberry Jam	15g	39	9.6	<0.1	<0.1
Yoghurt	125g	89	16.4	3.3	1.1
Total	-	**324**	**63.4**	**10.8**	**2.8**

Athletes performed a regular training between two

AT 2 meal		Energy (kcal)	CHO (g)	Protein (g)	Fat (g)
White Bread	1 slice, 80g	210	28	8	6
Chicken Ham	2 slices, 30g	36	0,6	5	1,4
Low fat cheese	2 slices, 40g	92	0,6	10,6	5,2
Yoghurt (high protein)	150g	70	5,7	11	0
Granola	40g	167	27,2	3,2	5,6
Custard tart	1 piece, 70g	142	21	2	5
Orange juice	330ml	145	34	2	0,1
Total	-	**862**	**117,1**	**41,8**	**23,3**

***Table 1**. Nutritional content of meal provided to AT1 participants. **Table 2.** Nutritional content of meal provided to AT2 participants*

VOC QUESTIONNAIRE DATA

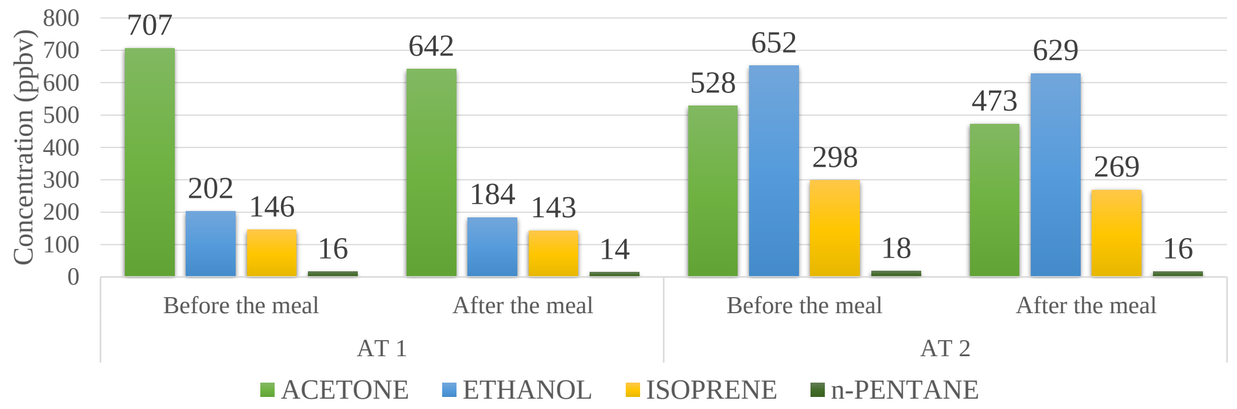


***Bar graph 1.** Summary of data collected via questionnaire for AT1 and AT2 participants combined*

RESULTS

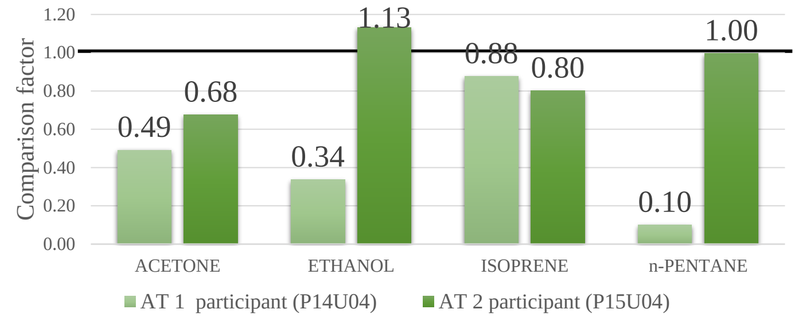
VOC QUANTIFICATION

Concentration levels for breath acetone, ethanol, isoprene and n-pentane were determined in samples before the meal (BM) and after the meal (AM).



***Bar graph 2.** Mean ppb concentration levels obtained for acetone, isoprene, ethanol and n-pentane for 24athlet4es who were in the steady state between two breath samplings (AT1), and 20 athletes who were physically active between two breath samplings (AT2).*

FOOD IMPACT ON BREATH VOCs



***Bar graph 3.** Comparison factor – calculated ratio between acetone, ethanol, isoprene and n-pentane levels determined in sample 120 min after the meal (AM) and levels in sample before the meal (BM) for AT1 and AT2 participants.*

	Food impact %	
	AT1	**AT2**
Acetone	75	55
Ethanol	79	55
Isoprene	33	70
n-Pentane	88	50

***Table 3.** Percentage of significantly altered VOC levels upon meal consumption. An increase or decrease in exhaled breath VOC level greater than 10% was considered as a significant change.*

LIFESTYLE IMPACT ON BREATH VOCs

Quantified exhaled breath VOCs levels and data collected via questionnaire were used for food impact assessment.

One-way ANOVA on ranks	p-value			
Categorical parameter	**Acetone**	**Ethanol**	**Isoprene**	**n-Pentane**
Participant group (AT1 vs. AT2)	**0.02**	**1.54E-08**	**1.29E-07**	0.71
Gender (male vs. female)	**0.01**	**1.94E-07**	**8.54E-07**	0.93
Working environment (rural vs. urban)	0.33	**2.00E-04**	**0.04**	0.32
Alcohol consumption (np vs. <2 drinks/week)	0.48	**7.66E-06**	**0.01**	**0.03**

***Table 4.** Summary of One-way ANOVA on ranks statistical tests results for several categorical parameters against VOC ppb_v levels obtained experimentally. Bolded p-values imply statistically significant difference between breath VOCs levels for distinct categories since p-value is below the treshold (α=0.05). The tested hypothesis assumed that there are no differences between categories.*

CONCLUSIONS

- VOC sensor has been successfully used for selected breath VOCs concentration levels determination.
- Significant change in selected breath VOCs levels upon meal consumption was observed in about 75-80% athletes who were in the steady state between two samplings for acetone and ethanol, 33% for isoprene, and 88% for n-pentane.
- Significant change in selected breath VOCs levels upon meal consumption was observed in 55% athletes who were physically active between two sampling for acetone and ethanol, 70% for isoprene and 50% for n-pentane.
- Statistically significant impact of participants' category, gender, working environment and alcohol consumption were observed for breath ethanol and isoprene levels. Acetone level was affected by participant category and gender, while n-pentane level was different among participants who consume alcohol and those who do not.
- Future work will be directed to expansion of the number of VOCs monitored.

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