Study of VOCs emissions from leaves of main four Portuguese tree species through headspace microextraction techniques in extreme fire conditions

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Introduction

Ongoing climatic changes have created more frequent drought and heat wave conditions that trigger the occurrence of Extreme Wildfire Events. Many dramatic consequences of wildfires are due to extreme fire behavior, with sudden changes in fire spread, in what have been termed as blow-up, eruptive or flashover fires. Studies have suggested that gases generated from heated vegetation, in particular volatile organic compounds (VOCs) may, under some topographic and atmospheric conditions, accumulate in locations where, after the arrival of the ignition source, they rapidly burst in flames as in explosions [1,2]. In this work, we proposed the application of bar adsorptive microextraction (BAμE) [3] and solid-phase microextraction (SPME) in the headspace (HS) mode, followed by gas chromatography coupled to mass spectrometry (GC-MS) analysis, to evaluate the VOCs emissions from the leaves of the four main Portuguese tree species (*P. pinaster*, *E. globulus*, *Q. suber* and *Q. robur*) when subjected to aggressive environments at high temperatures. Preliminary data obtained, suggest that HS-BAμE technique seems to be the ideal alternative analytical approach, to determine the majority VOCs from the leaf matrices and, in this sense, to study their flammability potential in fires that occur under extreme conditions.

Experimental Procedure

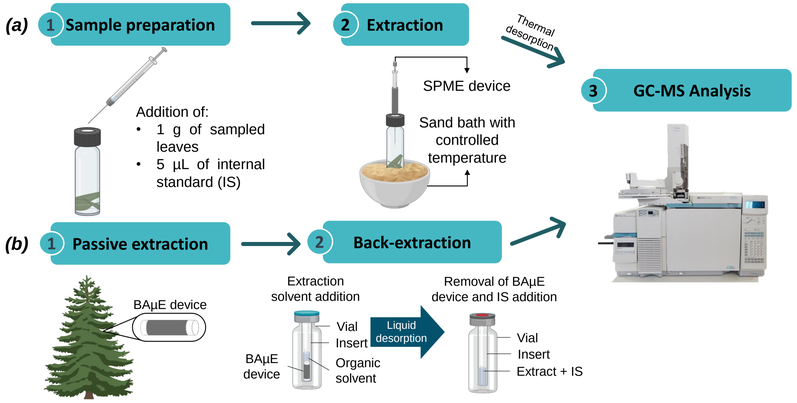

Figure 1. *Schematic methodology proposed for: (a) SPME/GC-MS analysis of VOCs released from sampled leaves at different temperatures and (b) HS-BAμE/GC-MS study of VOCs released from trees on different days.*

Results

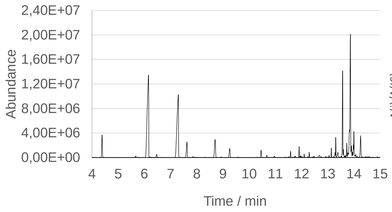

Figure 2. *Total ion chromatogram obtained from SPME/GC-MS analysis of P. pinaster leaves VOCs emission at 50 °C.*

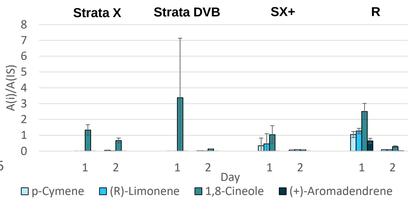

Figure 3. *Study of different sorbent phases used on HS-BAμE/GC-MS analysis of majority VOCs around E. globulus on different days.*

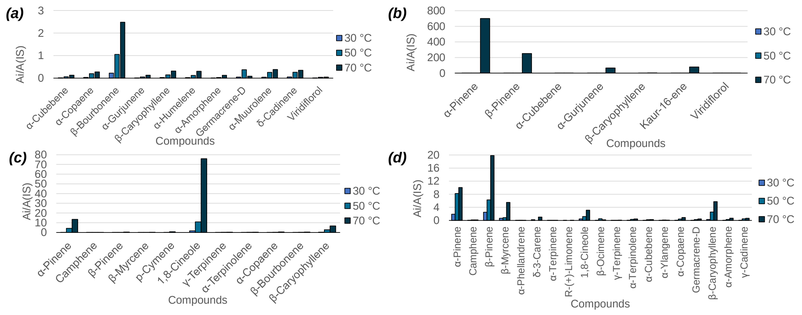

Figure 4. *Temperature effect on SPME/GC-MS analysis of VOCs released from different tree leaves: (a) Q. robur, (b) Q. suber, (c) E. globulus and (d) P. pinaster.*

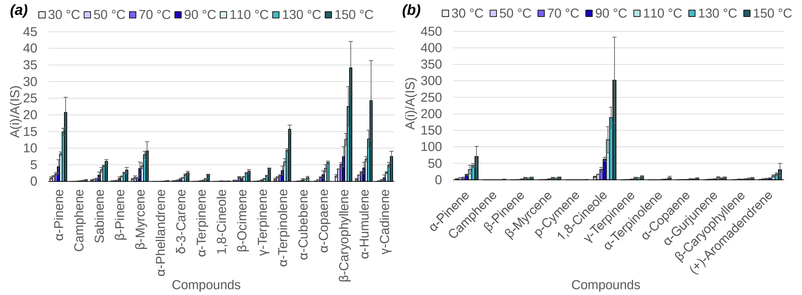

Figure 5. *Extreme temperatures effect on SPME/GC-MS analysis of VOCs released from different tree leaves. (a) P. pinaster and (b) E. globulus.*

Conclusions

- In general, an increment on the environment temperature suggests higher VOCs emission from the leaves of these four tree species;
- The main VOCs emitted by the tree leaves in the conditions studied are 1,8-cineole, α-pinene, β-pinene, β-myrcene and β-caryophyllene;
- The SPME/GC-MS analysis of VOCs emitted by *Eucalyptus globulus* leaves suggests that, in relation to the other species, these compounds are found in a higher proportion in this one;
- HS-BAμE technique suggests being a novel analytical approach for the determination of major VOCs from these leaf matrices;
- The results of preliminary assays encourage further investigation on the application of HS-BAμE and SPME methodologies for the analysis of VOCs variation in tree leaves.

References

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Acknowledgments

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