BIOMONITORING OF PAHS AND OXYGENATED DERIVATIVES (OPAHS)

C. Walgraeve (1), F, Van der Elst (1), P. De Wispelaere (1), H. Van Langenhove (1)

(1) Research group EnVOC (Environmental Organic Chemistry and Technology), Faculty of Bioscience Engineering,
Ghent University, Coupure Links 653, 9000 Ghent, Belgium
Presenting author email:Christophe.Walgraeve@UGent.be/Christophe.Walgraeve@Gmail.com

Summary

An analytical method for the quantification of the 16 priority US-EPA PAHs and 12 oxygenated PAHs in *Taxus baccata* leaves was developed and optimized. This is the first method developed, which is able to quantify PAHs and Oxy-PAHs in a plant species during the same analytical run. Emphasis is given to the optimization of the pressurized solvent extraction, clean up using solid phase extraction and high resolution mass spectrometry. The developed method is used to quantify PAHs and oxy-PAHs concentration levels in *Taxus baccata* leaves sampled in Ghent, Belgium during spring 2015.

Introduction

PAHs and their derivatives are widespread in the environment. They are formed during incomplete combustion processes (including both natural and anthropogenic sources). Oxygenated PAHs are also formed by secondary reactions in the atmosphere (Walgraeve et al., 2010). These persistent organic pollutants are harmful for humans and oxygenated PAHs contribute to the generation of reactive oxygen species ROS) in lung cells. In Flanders, mainly non-substituted PAHs are measured on particulate matter samples. The high volume sampling of particulate matter is however expensive, time consuming and labour intensive. An alternative with respect to the conventional techniques is biomonitoring. Hereby, plant species are investigated with respect to their PAHs/oxy-PAHs concentration levels, which are indicative for the pollutant concentrations in the atmosphere. The more volatile PAHs and oxy-PAHs are absorbed, while less volatile PAHs and oxy-PAHs are physically deposited on the plant surface.

Methodology and Results

Pressurized liquid extraction with dichloromethane as extraction solvent was applied. Different PLE extraction temperatures (between 50 and 200 °C) were evaluated. The possibility for in-cell clean up with Florisil was checked. Based the recoveries and matrix effects factors, an extraction temperature of 200 °C using 1 g Florisil in the cell was finally selected as the optimal condition. The clean up was not sufficient and further clean up was necessary. For the purification step, elution over solid phase extraction cartridge (Florisil) was optimised. Different solvents (cyclohexane, dichloromethane) and mixtures were evaluated and breakthrough profiles were obtained. The obtained cleaned up extract was finally analysed with GC-HRMS (mass resolution: 10 000). The mass spectrometer was run in multiple ion detection (MID-mode). This enabled to detect and quantify the compounds with high confidence.

Recoveries of the target compounds were ranging from 29 % to 110 %. Matrix effects were determined and ranged from 60 % to 140 %. The method was applied to *Taxus baccata* samples obtained from several sampling locations (traffic congested sites, background sites) in Ghent. This is the first biomonitoring study in Ghent for PAHs and oxy-PAHs. The concentration levels were in the lower ng/g dw. The presence of significant amounts of Oxy-PAHs in *Taxus baccata* was confirmed. This means that these oxygenated PAHs are important pollutants and should be included in future monitoring studies. Diagnostic ratio's showed the 16 US-EPA PAHs were the result of pyrogenic processes and traffic emissions in particular.

Conclusions

A new analytical method based on high resolution mass spectrometry was developed to determine trace concentration levels in a common plant in the area around Ghent. The different steps in the analytical process were thoroughly investigated and optimized. Recoveries and matrix effects were determined. The final method was applied in a measuring campaign conducted in Spring 2015. The results indicate that oxy-PAHs concentrations are significant when compared with the PAHs concentration levels.

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References

Walgraeve, C., Demeestere, K., Dewulf, J., Zimmermann, R., Van Langenhove, H. (2010). Oxygenated polycyclic aromatic hydrocarbons in atmospheric particulate matter: molecular characterization and occurrence. Atmospheric Environment 44, 1831-1846.