ASOCIACIÓN DE QUÍMICOS DE GALICIA

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SOCIEDADE PORTUGUESA DE QUÍMICA

XXVI ENCONTRO GALEGO PORTUGUÉS DE QUÍMICA

CONGRESO INTERNACIONAL

FACULTAD DE QUÍMICA

2022

16 17 18 NOVIEMBRE

SANTIAGO DE COMPOSTELA

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GC-MS screening method for the identification of semi-volatile compounds in bio-based and biodegradable food packaging materials

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Bio-based and biodegradable plastics are being used for food packaging applications as an alternative to conventional plastics derived from petroleum feedstocks due to the environmental pollution originated by the use of traditional petroleum-based non- biodegradable polymers [1, 2].

Bio-based polymers like other food contact materials may transfer low molecular weight constituents into the food and therefore represent a risk for the consumers' health. However, the chemical safety of these sustainable materials has been scarcely studied [1].

In the present work, a Gas Chromatography coupled to Mass Spectrometry (GC-MS) screening method for the identification of semi-volatile components in bio-based and biodegradable food packaging materials was developed. Six different plastic materials labeled as biodegradable, bio-based or compostable were collected to carried out the study. The samples, including bags for foodstuff and films were provided by the industry and acquired from retailers. In developing the extraction method, two solvents, i.e., methanol and acetonitrile at 70ºC for 24 h were tested. The best results in terms of the number of extracted compounds was obtained with methanol.

The chromatographic conditions used were the following: the carrier gas used was He using a flow of 1 mL/min. The extracts were analysed by GC-MS using Electron Ionization (EI) in full scan mode (35-500 m/z). The separation of the compounds was made using a Rxi-5SilMS (30 m x 0.25 mm, 0.25 µm) column as stationary phase. The oven ramp temperature was from 40 to 300 ºC and the transfer line and detector temperatures were 300 ºC.

The method has proved useful for the determination of low molecular weight compounds, which can potentially migrate into the food. A wide variety of compounds including 7,9-di-tert-butyl-1-oxaspiro(4,5)deca-6,9-diene-2,8-dione, Tributyl acetylcitrate (ATBC), Diethyl phthalate (DEP), 9-octadecenamide among others were identified. The identification of the different compounds was obtained by comparison with spectral libraries such as NIST/EPA/NIH 2020 and Wiley RegistryTM 12th edition. It is also interesting to highlight that some compounds detected (e.g., benzophenone, 9-octadecenamide, 13-docosenamide) exhibited high toxicity (Class III) according to Cramer rules.

The proposed method allowed the rapid identification of potential semi-volatile migrants in the bio-based packaging materials. It could be used as a screening tool for the selection of relevant substances the migration of which should further be studied in specific migration tests.

Acknowledgements
The study was financially supported by the Ministerio de Ciencia e Innovación, Agencia Estatal de Investigación and by Fondo Europeo de Desarrollo Regional (FEDER). Ref.No. PID2021-124729NB-I00 "MIGRABIOQUANT" (MCIN/AEI/ 10.13039/501100011033/FEDER, UE).
Authors are grateful to the Ministerio de Ciencia, Innovación y Universidades for the Predoctoral fellowship (ref. PRE2019-088195) awarded to P.V.L.

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