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Non-targeted lipidomics using LC-orbitrap HRMS and chemometrics to discriminate beef, pork, and goat meat for halal authentication

[Lipidómica no dirigida mediante LC-Orbitrap HRMS y quimiometría para discriminar carne de vacuno, cerdo y cabra para la autenticación halal]

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Abstract

This study presents a non-targeted lipidomic approach using liquid chromatography-high-resolution mass spectrometry (LC-HRMS) coupled with chemometric analysis to discriminate between beef, pork, and goat meat. Lipid extracts from the three meat types were analyzed using reversed-phase LC-HRMS, generating comprehensive lipid profiles. Chemometrics methods, including principal component analysis (PCA) and partial least squares-discriminant analysis (PLS-DA), wereemployed to identify distinct lipid signatures capable of differentiating the meat samples. The results revealed various lipid classes, and triglycerides became the highest percentage of lipids contained in pork obtained from the positive ionization mode. Compounds of TG (52:1COOH_18:0), PE (O_36:1) and, DG (17:0_18:2) showed good capacity for discriminating pork, and further potential as biomarker candidates. The resulting models demonstrated high classification accuracy, highlighting specific lipid species which contribute significantly to the discrimination. These findings directly support the potential application for halal authentication in the meat industry, as the potential lipid markers can be further validated in binary mixtures, processed products, and real-market samples. © 2026 CSIC. This is an open access article distributed under the terms of the Creative Commons Attribution 4.0 International (CC BY 4.0) License.

Author keywords

Biomarcador lipídico; Carne de cerdo; Chemometrics; LC-HRMS; LC-HRMS; Lipid biomarker; lipidomics; Lipidómica no dirigida; Non-targeted; Pork; Quimiometría

Indexed keywords

Engineering controlled terms

Authentication; Binary mixtures; Biomarkers; Chromatographic analysis; Copper compounds; Drug products; Ionization potential; Least squares approximations; Lipids; Liquid chromatography; Mass spectrometry; Meats; Principal component analysis

Engineering uncontrolled terms

Biomarcador lipidico; Carne de cerdo; Chemometrices; Lipid biomarkers; Lipidomica no dirigida; Lipidomics; Liquid chromatography-high resolution mass spectrometries; Non-targeted; Pork; Quimiometria

Engineering main heading

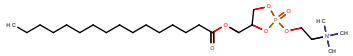
Discriminant analysis

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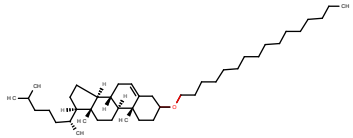
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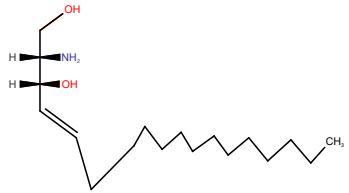
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