

ABSTRAK

Eni Komsatun. 2026. Eksplorasi Fosfatidiletanolamin (PE) untuk Autentikasi Kehalalan Produk Olahan Daging Menggunakan Pendekatan Lipidomik Kombinasi Kemometrik. Skripsi. Program Studi Farmasi, FIKS, Universitas PGRI Madiun. Pembimbing (I) Dr. apt. Vevi Maritha, S.Farm., M.Farm, Pembimbing (II) Puri Ratna Kartini, S.KM., M.Epid.

Tingginya populasi Muslim dan kesadaran konsumsi halal mendorong pentingnya autentikasi produk olahan daging yang sulit diidentifikasi akibat proses pengolahan yang kompleks. Oleh karena itu, digunakan pendekatan *targeted* lipidomik berbasis UHPLC-HRMS yang sensitif dan selektif untuk membedakan profil lipid antar sampel. Penelitian ini bertujuan mengeksplorasi fosfatidiletanolamin (PE) sebagai biomarker potensial dalam autentikasi produk olahan daging sapi dan babi (sosis, kornet, dan nugget). Analisis dilakukan menggunakan UHPLC-HRMS pada mode ESI+ dan ESI-, dilanjutkan dengan analisis kemometrik PCA, kluster, dan PLS-DA. Hasil menunjukkan adanya perbedaan profil PE antar sampel, dengan terdeteksi 491 lipid PE pada mode ESI+ dan 6 lipid PE pada ESI-. Analisis PCA dilakukan secara terpisah pada masing-masing jenis sampel sapi dan babi. Hasil menunjukkan pemisahan sampel yang jelas, menandakan adanya perbedaan karakteristik profil lipid PE. Analisis kluster mampu mengelompokkan sampel daging sapi dan babi secara jelas, yang ditunjukkan melalui pemisahan pada dendrogram. Hasil analisis PLS-DA menunjukkan nilai R^2 sebesar 0,831 yang mengindikasikan bahwa model memiliki kemampuan yang baik dalam menjelaskan varians data. Senyawa lipid PE(18:4/17:1), PE(6:0/16:1), PE(17:4/18:1), PE(18:3/17:2), PE(14:0e/22:5), PE(14:0p/22:4), PE(16:0e/20:5), PE(16:1/19:4), PE(16:1e/20:4), PE(16:1p/20:3), PE(18:1p/18:3), PE(18:2e/18:3), PE(18:2p/18:2), PE(22:4/13:1), dan PE(22:5/13:0) teridentifikasi sebagai kandidat marker potensial. Dengan demikian, pendekatan ini efektif dalam mendukung autentikasi kehalalan produk olahan daging.

Kata kunci: *targeted* lipidomik; fosfatidiletanolamin (PE); UHPLC-HRMS; kemometrik; autentikasi halal; produk olahan daging.

ABSTRACT

Eni Komsatun. 2026 *Exploration of Phosphatidylethanolamine (PE) for Halal Authentication of Processed Meat Products Using a Combined Lipidomics and Chemometric Approach*. Program Studi Farmasi, FIKS, Universitas PGRI Madiun. Advisor (I) Dr. apt. Vevi Maritha, S.Farm., M.Farm, Co-Advisor (II) Puri Ratna Kartini, S.KM., M.Epid..

The large Muslim population and increasing awareness of halal consumption highlight the importance of authenticating processed meat products, which are often difficult to identify due to complex processing. Therefore, a sensitive and selective UHPLC-HRMS-based targeted lipidomics approach was employed to distinguish lipid profiles among samples. This study aims to explore phosphatidylethanolamine (PE) as a potential biomarker in the authentication of processed beef and pork products (sausages, corned beef, and nuggets). Analysis was performed using UHPLC-HRMS in ESI+ and ESI- modes, followed by chemometric analysis including PCA, clustering, and PLS-DA. The results showed differences in PE profiles among samples, with 491 PE lipids detected in ESI+ mode and 6 PE lipids in ESI- mode. PCA analysis was performed separately for each type of beef and pork sample. The results showed clear sample separation, indicating differences in the characteristics of the PE lipid profiles. Cluster analysis was able to clearly group the beef and pork samples, as demonstrated by the separation in the dendrogram. The PLS-DA analysis results showed an R^2 value of 0.831, indicating that the model has a good ability to explain the data variance. Lipid compounds PE(18:4/17:1), PE(6:0/16:1), PE(17:4/18:1), PE(18:3/17:2), PE(14:0e/22:5), PE(14:0p/22:4), PE(16:0e/20:5), PE(16:1/19:4), PE(16:1e/20:4), PE(16:1p/20:3), PE(18:1p/18:3), PE(18:2e/18:3), PE(18:2p/18:2), PE(22:4/13:1), and PE(22:5/13:0) were identified as potential marker candidates. Therefore, this approach is effective in supporting the halal authentication of processed meat products.

Keywords: *targeted lipidomics; phosphatidylethanolamine (PE); UHPLC-HRMS; chemometrics; halal authentication; meat product.*