

INTISARI

FUNGSIONALISASI *ELECTRONIC NOSE* UNTUK MENDIFERENSIASI RAMBAK KULIT DARI BABI, KAMBING, DAN KERBAU YANG DIKOMBINASIKAN DENGAN *MACHINE LEARNING*

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Penelitian ini mengaplikasikan *electronic nose* (*e-nose*) yang dilengkapi delapan sensor gas berbasis semikonduktor untuk mendeteksi dan membedakan jenis rampak berdasarkan bahan bakunya, yaitu kulit babi, kambing, dan kerbau. Identifikasi jenis rampak penting dilakukan karena secara visual bahan baku rampak sulit dibedakan. Metode autentikasi konvensional seperti *Gas Chromatography-Mass Spectrometry* (GC-MS) dan *Fourier Transform Infrared* (FTIR) memiliki keterbatasan berupa waktu analisis yang lama, biaya mahal, dan membutuhkan operator ahli. Sampel rampak kulit mentah tanpa bumbu diperoleh dari tiga produsen dengan total 50 data pengukuran berulang untuk setiap jenis bahan baku. Pengujian dilakukan pada suhu 60°C tanpa variasi suhu. Data respon sensor diproses dan dianalisis menggunakan *Principal Component Analysis* (PCA) untuk klusterisasi awal dan machine learning berbasis *Linear Discriminant Analysis* (LDA) untuk klasifikasi. Data dipecah menjadi 80% untuk pelatihan dan 20% untuk pengujian dengan metode *k-fold cross-validation* guna memastikan konsistensi model. Hasil penelitian menunjukkan bahwa prototipe *e-nose* berhasil mengklasifikasikan jenis rampak berdasarkan bahan bakunya, dengan tingkat variabilitas klusterisasi sebesar 72,41% menggunakan PCA dan akurasi pengujian model sebesar 90% menggunakan LDA. Penelitian ini membuktikan bahwa *e-nose* dapat menjadi alat autentikasi yang efisien, hemat biaya, non-destruktif, dan mudah digunakan, khususnya untuk produk berbasis bahan baku kulit.

Kata Kunci: *Electronic nose*, rampak kulit, *Principal Component Analysis* (PCA), *Linear Discriminant Analysis* (LDA), autentikasi bahan baku

ABSTRACT

FUNCTIONALIZATION OF AN ELECTRONIC NOSE FOR DIFFERENTIATION SKIN CRACKERS FROM PIG, MUTTON, AND BUFFALO COMBINED WITH MACHINE LEARNING

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This study aims to apply an electronic nose (e-nose) equipped with eight semiconductor-based gas sensors to detect and differentiate types of rambak (crackers) made from pig, goat, and buffalo skin. Identifying the raw materials of rambak is crucial, as they are visually indistinguishable. Conventional authentication methods such as Gas Chromatography-Mass Spectrometry (GC-MS) and Fourier Transform Infrared (FTIR) spectroscopy are effective but have limitations, including long processing times, high costs, and the requirement for skilled operators. Raw rambak samples were commercially obtained from three different producers, with each type of rambak providing 50 repeated measurements using the e-nose. The samples were unseasoned and tested at a constant temperature of 60°C. Sensor response data were processed and analyzed using Principal Component Analysis (PCA) for clustering and Linear Discriminant Analysis (LDA) for classification. The dataset was divided into 80% for training and 20% for testing, with k-fold cross-validation employed to ensure model consistency. The results showed that the e-nose prototype successfully classified the rambak types based on their raw materials, achieving 72.41% variability in clustering using PCA and a 90% testing accuracy using LDA. These findings demonstrate that the e-nose, combined with advanced pattern recognition techniques, can serve as an efficient, cost-effective, non-destructive, and user-friendly detection tool.

Keywords: Electronic nose, Rambak crackers, principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), raw material authentication.