

INTISARI

KLASIFIKASI POLA AROMA VARIETAS KOPI MENGGUNAKAN *ELECTRONIC NOSE* BERBASIS PCA-LDA PADA *MACHINE LEARNING*

Firyal Imtiyaz

21/480321/SV/19610

Kopi merupakan komoditas perkebunan dengan nilai ekonomi dan budaya tinggi. Varietas Arabika, Robusta, dan Liberika memiliki aroma khas dari senyawa volatil hasil pemanggangan. Kompleksitas aroma membuat identifikasi dengan indera manusia subjektif dan kurang konsisten, sehingga diperlukan metode cepat, objektif, dan non-destruktif untuk autentikasi serta pengendalian mutu. Penelitian ini bertujuan mengenali pola aroma tiga varietas kopi menggunakan *electronic nose (e-nose)* berbasis sembilan sensor *Metal Oxide Semiconductor* (MOS) yang dipadukan dengan *Principal Component Analysis* (PCA) dan *Linear Discriminant Analysis* (LDA). Akuisisi aroma dilakukan melalui tiga fase, yaitu *flushing* (10 s), *collecting* (30 s), dan *purging* (60 s), dengan lima kali pengulangan pada setiap varietas. Sinyal sensor dipra-proses dengan *noise filtering*, *baseline correction*, dan *normalisasi*, kemudian diekstraksi menjadi fitur statistik dan spektral. Seleksi fitur dilakukan dengan *Feature Importance*, *Cross Validation*, dan *Correlation Filtering* untuk memperoleh fitur paling relevan. Hasil menunjukkan bahwa PCA mampu mentransformasikan data ke ruang komponen utama, sehingga distribusi pola aroma kopi dapat divisualisasikan secara jelas dengan dua komponen utama yang menjelaskan lebih dari 95% variansi total. Klasifikasi menggunakan LDA, *K-Nearest Neighbor* (KNN), dan *Random Forest* menghasilkan performa tinggi, di mana KNN dan *Random Forest* mencapai akurasi 100%, sedangkan LDA berkisar antara 91–94%. Temuan ini membuktikan bahwa *e-nose* berbasis MOS efektif untuk identifikasi varietas kopi serta berpotensi mendukung autentikasi dan menjaga mutu produk.

Kata kunci : Kopi, *electronic nose*, MOS, PCA, LDA, KNN, *Random Forest*

ABSTRACT

CLASSIFICATION OF COFFEE VARIETY AROMA PATTERNS USING AN ELECTRONIC NOSE BASED PCA-LDA IN MACHINE LEARNING

Firyal Imtiyaz

21/480321/SV/19610

Coffee is an agricultural commodity with high economic and cultural value. The Arabica, Robusta, and Liberica varieties have distinctive aromas derived from volatile compounds produced during roasting. The complexity of coffee aroma makes identification by human senses subjective and inconsistent, requiring a fast, objective, and non-destructive method for authentication and quality control. This study aims to recognize the aroma patterns of three coffee varieties using an electronic nose (e-nose) based on nine Metal Oxide Semiconductor (MOS) sensors, combined with Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA). Aroma acquisition was carried out in three phases: flushing (10 s), collecting (30 s), and purging (60 s), with five repetitions for each variety. The sensor signals were pre-processed using noise filtering, baseline correction, and normalization, then extracted into statistical and spectral features. Feature selection was performed using Feature Importance, Cross Validation, and Correlation Filtering to obtain the most relevant features. The results show that PCA successfully transformed the data into the principal component space, allowing clear visualization of the aroma distribution with two main components explaining more than 95% of total variance. Classification using LDA, k-Nearest Neighbor (KNN), and Random Forest achieved high performance, with KNN and Random Forest reaching 100% accuracy, while LDA ranged between 91–94%. These findings demonstrate that the MOS-based e-nose is effective for coffee variety identification and has strong potential to support authentication and quality maintenance.

Keyword: coffee, electronic nose, mos, PCA, LDA, KNN, Random Forest