

INTISARI

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Biji kakao yang baik berdasarkan SNI 01-2323-2018 terdiri atas tiga jenis yakni *fine cacao dark bean* < 20%, *fine cacao dark bean* > 60%, dan *bulk cacao*. Secara visual, ketiganya sulit dibedakan satu sama lain sehingga diperlukan alat khusus yang dapat mendeteksi aroma atau rasanya. Penelitian ini mengkaji unjuk kerja beberapa jenis *machine learning* dalam mengklasifikasi jenis biji kakao berdasarkan hasil pengukuran menggunakan *electronic nose* (*E-nose*). Biji kakao standar diperoleh dari PT Perkebunan Nusantara 12 (PTPN) Surabaya tanpa perlakuan khusus. Dalam penelitian ini, *machine learning* yang dikaji unjuk kerjanya adalah *principal component analysis* (PCA), *linear discriminant analysis* (LDA) dan *support vector machine* (SVM). Sebelum penerapan *machine learning*, sinyal respon larik sensor dilakukan prapemrosesan data dan dilanjutkan dengan ekstraksi ciri menggunakan metode *maximum*, *AUC of timeset*, dan *piecewise coefficient*. Klasifikasi biji kakao menggunakan *machine learning* khususnya SVM dilakukan dengan membagi dataset eksperimen menjadi dua yaitu untuk keperluan pelatihan atau *training* dan keperluan validasi eksternal (*testing*). Selanjutnya, model klasifikasi terbaik dengan optimasi hiperparameter nilai $C = 100$, $\gamma = 0,01$ dan *varian cross-validation* dengan nilai $K\text{-fold} = 10$ diimplementasikan selama prosedur pelatihan. Hasil terbaik diperoleh ketika kombinasi antara ekstraksi ciri *piecewise coefficient* dengan SVM hingga diperoleh akurasi total *training* dan *testing* masing-masing adalah 99,58% dan 95,00%. Oleh karena itu, ketiga jenis biji kakao dapat diklasifikasikan dengan menerapkan unjuk kerja *machine learning* pada hasil pengukuran menggunakan *e-nose* sehingga dapat diterapkan untuk industri kakao yang membutuhkan persiapan sampel minimum dan sederhana.

ABSTRACT

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Good cocoa beans based on SNI 01-2323-2018 consist of three types, namely fine cacao dark bean <20%, fine cacao dark bean> 60%, and bulk cacao. Visually, the three are difficult to distinguish from each other so special tools are needed that can detect the aroma or taste. This study examines the performance of several types of machine learning in classifying the types of cocoa beans based on the measurement results using electronic nose (E-nose). Standard cocoa beans are obtained from PT Perkebunan Nusantara 12 (PTPN) Surabaya without special treatment. In this study, machine learning reviewed by its performance is principal component analysis (PCA), linear discriminant analysis (LDA) and support vector machine (SVM). Before the application of machine learning, sensor array response signals were pre-processing data and followed by feature extraction using the maximum method, AUC of timeset, and piecewise coefficient. The classification of cocoa beans using machine learning especially SVM is done by dividing the experimental dataset into two, namely for the purposes of training or training and the need for external validation (testing). Furthermore, the best classification model with hyperparametric optimization values $C = 100$, $\gamma = 0.01$ and cross-validation variants with K-fold value = 10 are implemented during the training procedure. The best results are obtained when the combination of piecewise coefficient feature extraction with SVM until the accuracy of total training and testing is 99.58% and 95.00% respectively. Therefore, the three types of cocoa beans can be classified by applying machine learning performance on the measurement results using e-nose so that it can be applied to the cocoa industry which requires minimum and simple sample preparation.