

INTISARI

Desain Metode Prediksi Kadar Senyawa dan Komponen Utama Minyak Atsiri Herbal Menggunakan *Electronic-Nose* berbasis *Knowledge based Conceptual Neural Networks*

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Saat ini *electronic nose (e-nose)* telah banyak digunakan untuk membangun sistem pengujian dan pengenalan sampel aromatik bahan organik berdasarkan pola larik sensor dari aroma sampel. Pada umumnya pengujian tersebut dilakukan secara kualitatif tanpa memberikan informasi mengenai kadar senyawa dan komponen utama yang membedakan sampel uji.

Pada penelitian ini diusulkan metode baru untuk membangun mesin pembelajaran yang mampu memberikan informasi kadar senyawa dan komponen utama sampel uji berdasarkan pola larik sensor *e-nose* dengan mengintegrasikan jaringan syaraf tiruan propagasi balik (JST-BP) dan *Knowledge-based Conceptual Neural Networks (KBCNN)*. JST-PB digunakan untuk prediksi kadar senyawa dan komponen utama dalam bahan, sedangkan KBCNN untuk klasifikasi jenis bahan herbal berdasarkan komponen utama.

Penelitian ini difokuskan terhadap empat hal: (1) ekstraksi dan seleksi fitur terhadap data *e-nose*; (2) merancang JST-PB untuk memprediksi kadar senyawa dan komponen utama; (3) merancang KBCNN untuk klasifikasi jenis bahan herbal berdasarkan komponen utama; dan (4) evaluasi kinerja model klasifikator terhadap prediksi kadar dan komponen utama bahan herbal.

Eksperimen dilakukan terhadap 7 bahan herbal: jahe, kencur, kunyit, kunyit putih, lengkuas, nilam, dan temulawak. Setiap jenis bahan dilakukan pengukuran menggunakan *e-nose* dan SPME GC/MS dengan variasi 80 sampel untuk setiap jenisnya. Selanjutnya dilakukan ekstraksi fitur untuk memperoleh data latih dan data uji dalam membangun model. Fitur yang digunakan adalah 7 parameter: amplitudo relatif (AR), *surface* (SF), *kurtosis* (K), *skewness* (SK), kombinasi AR+SF, kombinasi AR+SF+K+SK dan dekomposisi wavelet. Seleksi fitur dengan *principle component analysis* (PCA), *linear discriminant analysis* (LDA), dan analisis kluster menunjukkan bahwa parameter AR, kombinasi AR+SF, dan kombinasi AR+SF+K+SK merupakan parameter-parameter yang efektif untuk membangun sistem.

Hasil eksperimen menunjukkan bahwa metode yang diusulkan memberikan akurasi yang sangat tinggi. Prediksi terhadap kadar senyawa dan komponen utama menggunakan JST-BP memberikan akurasi sebesar 99,25% sedangkan klasifikasi 7 jenis bahan herbal berdasarkan komponen utama menggunakan KBCNN memperoleh akurasi 97,09%. Dengan demikian maka dapat disimpulkan bahwa metode yang diusulkan dapat digunakan sebagai metode analisis semikuantitatif dengan akurasi yang sangat tinggi terhadap bahan herbal yang diuji.

Keywords: e-nose, bahan herbal, analisis semikuantitatif, Knowledge-based Conceptual Neural Networks (KBCNN)

ABSTRACT

Design of Prediction Method of Compound Concentration and Main Component On Herbal Essential Oils Using Electronic Nose Based On Knowledge Based Conceptual Neural Networks

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Currently, the electronic nose (e-nose) has been widely used to build testing and recognition system of aromatic organic materials based on sensor array pattern. In general, the testing was applied qualitatively without giving information of compounds concentration and major components.

In this study, it is proposed a new method for building a learning machine that can provide information about compound concentration and the main components of the testing sample based on the pattern of sensor array of the e-nose. The learning machine was designed by integrating back propagation neural network (BPANN) and knowledge-based conceptual neural networks (KBCNN). The BPANN was used to predict the concentration of compound levels and the main components in the sample, while the KBCNN was used as the classifier for herbal medicines based on the main component of them.

This study focused on four things: (1) Conducting feature extraction and feature selection of e-nose data. (2) Designing BPANN for predicting the concentration of the compound and the main component. (3) Designing KBCNN for classifying of kinds of herbal medicines based on the main components and (4) Evaluating the performance of classifier model for predicting the concentration of the compound and the main component.

The experiment was conducted on seven kinds of herbal medicines: ginger, lesser galangal, turmeric, zedoary, greater galangal, patchouli, and wild ginger. Each kind of herbals is measured using the e-nose and SPME-GC / MS with a variation of 80 samples for each herbal. Furthermore, feature extraction of e-nose data was conducted to obtain training and testing data to build the model. Feature extraction was used seven parameters: the relative amplitude (AR), surface (SF), kurtosis (K), skewness (SK), AR + SF combination, the combination of AR + SF + K + SK and wavelet decomposition. Selection feature by principle component analysis (PCA), linear discriminant analysis (LDA), and cluster analysis showed that the parameters of AR, AR + SF combination, and the combination of AR + SF + K + SK are the most efficient parameters for building the system.

The experimental results showed that the proposed method provides very high accuracy for prediction system. Prediction of the concentration of compounds and the main components using BPANN provides an accuracy of 99.25%, while the classification of seven kinds of herbal medicines based on the main components using KBCNN obtained 97.09% accuracy. Thus it can be concluded that the proposed method can be applied as a semi quantitative analysis method with a very high accuracy of on herbal medicine samples.

Keywords: e-nose, herbal medicine, semi quantitative analysis, knowledge-based conceptual neural networks (KBCNN)