



INTISARI

APLIKASI SISTEM LARIK SENSOR GAS UNTUK IDENTIFIKASI PROFIL AROMA TEMPE SELAMA PROSES FERMENTASI

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Sistem larik sensor gas yang terdiri dari sensor gas tipe TGS813, TGS822, TGS2600, TGS826, TGS2611, TGS2620, TGS2612, dan TGS2602 yang dikombinasikan dengan sistem pengenalan pola telah berhasil diterapkan untuk mengidentifikasi profil aroma tempe kedelai selama proses fermentasi. Tujuan dalam penelitian ini adalah menyelidiki profil respon larik sensor gas terhadap aroma tempe selama proses fermentasi, melakukan ekstraksi ciri hasil luaran respon sistem larik sensor gas, dan melakukan verifikasi profil aroma tempe terhadap pertumbuhan mikroorganisme dengan menggunakan metode *total plate count* (TPC) dan analisis visual dengan menggunakan *scanning electron microscope* (SEM). Profil aroma tempe diperoleh dari respon keluaran sistem larik sensor gas yang berupa tegangan terukur yang sebanding dengan konsentrasi gas yang dihasilkan selama proses fermentasi. Sistem larik sensor gas diset dengan waktu satu menit *sensing* dan satu menit *purging*. Metode *baseline* diferensial digunakan dalam prapemrosesan data respon sistem larik sensor gas. Selanjutnya, ekstraksi ciri dengan mengambil nilai maksimum dari respon larik sensor gas. *Principle Component Analysis* (PCA) digunakan sebagai metode sistem pengenalan pola. Hasil pengujian menunjukkan ada empat tahap dalam proses fermentasi tempe, yaitu tahap pertumbuhan spora jamur, tahap fermentasi oleh jamur, tahap perubahan jenis mikroorganisme yang berperan dalam proses fermentasi, dan tahap fermentasi oleh bakteri. Selain itu, diperoleh informasi bahwa aroma yang dihasilkan saat fermentasi oleh jamur berbeda dengan aroma yang dihasilkan saat fermentasi oleh bakteri. Diperoleh hasil korelasi yang baik antara profil aroma tempe dengan perkembangan mikrobiologi selama proses fermentasi tempe.

Kata kunci : sensor gas, aroma, fermentasi, sistem larik sensor gas (*electronic nose*), *principal component analysis*, fermentasi, tempe



ABSTRACT

APPLICATION OF GAS SENSOR ARRAY SYSTEM FOR IDENTIFYING TEMPEH'S AROMA PROFILE DURING FERMENTATION PROCESS

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Gas sensor array system consisting of gas sensor types TGS813, TGS822, TGS2600, TGS826, TGS2611, TGS2620, TGS2612, and TGS2602 respectively combined with pattern a recognition system has been successfully applied to identify the aroma profile of soybean during the fermentation process. The aim of this study is to investigate the response profile as a representation of the aroma tempeh during the fermentation process using gas sensor array system. It was performed by extracting the feature the response of gas sensor array system and verifying profile of aroma tempeh with the growth of microorganisms by using total plate count (TPC) and visual analysis based on scanning electron microscope (SEM) images. The aroma profile of tempeh obtained from the output response of the gas sensor array in the form of a measurable voltage that is proportional to the concentration of volatile organic compounds (VOCs) emitted from tempeh samples during the fermentation process. For the measurement, the gas sensor array system was set up with a period of one-minute sensing and one-minute purging. The differential baseline method was applied for data pre-processing, while the maximum value of the response of each sensor was extracted for feature extraction. Finally, the principle component analysis (PCA) was employed for a supervised pattern recognition systems. It is found that there are four stages in the process of fermentation, i.e. the growth stage mold spores, fungal fermentation phase, phase changes in the types of microorganisms that play a role in the fermentation process, and the stage of fermentation by bacteria. In addition, these stages are in accordance with the activity of fungi and bacteria as indicated by TPC and SEM images. These results show feasibility of the gas sensor array system for rapid and real-time assessment in microbiology application, especially during the fermentation process of tempeh.

Keywords: gas sensor, aroma, fermentation, electronic nose, principal component analysis, tempeh