

**PENERAPAN *ELECTRONIC NOSE* DALAM PENGENALAN POLA
RESPONS SENSOR UNTUK DETEKSI KONTAMINASI *Lactobacillus
plantarum* PADA FERMENTASI NATA DE COCO**

INTISARI

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Nata de coco merupakan produk fermentasi air kelapa yang dihasilkan oleh *Acetobacter xylinum* dan banyak dikonsumsi karena kandungan seratnya yang tinggi. Namun, selama proses fermentasi, dapat terjadi kontaminasi oleh mikroorganisme lain, salah satunya *Lactobacillus plantarum*, yaitu bakteri asam laktat yang bersifat homofermentatif dan menghasilkan asam laktat sebagai metabolit utama. Keberadaan *Lactobacillus plantarum* dalam fermentasi nata de coco dapat mengganggu dominasi *Acetobacter xylinum*, mengubah profil senyawa volatil, dan menurunkan kualitas produk akhir, baik dari segi tekstur maupun aroma.

Penelitian ini bertujuan untuk mengidentifikasi pola respons sensor *electronic nose* terhadap senyawa volatil yang dihasilkan dan deteksi awal terjadinya kontaminasi berdasarkan perbedaan pola respons sensor *electronic nose* menggunakan PCA selama proses fermentasi nata de coco normal dan yang terkontaminasi *Lactobacillus plantarum*. Pengujian pada penelitian ini menggunakan *electronic nose* yang dikembangkan oleh UGM Science Technopark, dengan 10 sensor gas tipe *Metal Oxide Semiconductor* (MOS). Sampel gas diambil selama 7 hari fermentasi dengan interval pengambilan setiap 8 jam, kemudian dianalisis menggunakan metode *Principal Component Analysis* (PCA). Sebelumnya, data sensor diproses melalui pra-pemrosesan sinyal dan ekstraksi ciri menggunakan lima parameter statistik, yaitu gradien, median, maksimum, mean, dan standar deviasi.

Hasil penelitian menunjukkan bahwa terjadi perbedaan pola respons sensor antara fermentasi normal dan terkontaminasi *Lactobacillus plantarum*. Sensor S8 dominan pada fermentasi normal, sedangkan sensor S2 menjadi dominan pada fermentasi terkontaminasi *Lactobacillus plantarum* setelah pra-pemrosesan sinyal. Di antara lima parameter, mean merupakan ekstraksi ciri paling optimal dengan proporsi kumulatif varians tertinggi sebesar 80,94%. Analisis PCA menunjukkan pemisahan kluster yang signifikan sejak hari ke-5 fermentasi.

Kata kunci: nata de coco, *electronic nose*, *Lactobacillus plantarum*, senyawa volatil, *Principal Component Analysis* (PCA).

**APPLICATION OF ELECTRONIC NOSE IN SENSOR RESPONSE
PATTERN RECOGNITION FOR DETECT *Lactobacillus plantarum*
CONTAMINATION IN NATA DE COCO FERMENTATION**

ABSTRACT

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Nata de coco is a fermented coconut water product produced by *Acetobacter xylinum* and widely consumed due to its high dietary fiber content. However, during the fermentation process, contamination by other microorganisms may occur, including *Lactobacillus plantarum*, a homofermentative lactic acid bacterium that produces lactic acid as its main metabolite. The presence of *Lactobacillus plantarum* in nata de coco fermentation can disrupt the dominance of *Acetobacter xylinum*, alter the volatile compound profile, and reduce the final product quality in terms of both texture and aroma.

This study aims to identify the sensor response patterns of an electronic nose to the volatile compounds produced and to enable early detection of contamination based on differences in sensor response patterns using Principal Component Analysis (PCA) during the fermentation process of normal and *Lactobacillus plantarum* contaminated nata de coco. The electronic nose used in this study was developed by UGM Science Technopark and consists of ten Metal Oxide Semiconductor (MOS) gas sensors. Gas samples were collected over a 7-day fermentation period at 8-hour intervals and analyzed using Principal Component Analysis (PCA). Prior to analysis, the sensor data were pre-processed and feature extraction was performed using five statistical parameters: gradient, median, maximum, mean, and standard deviation.

The results of the study showed a distinct difference in sensor response patterns between normal fermentation and fermentation contaminated with *Lactobacillus plantarum*. Sensor S8 was dominant during normal fermentation, whereas sensor S2 became dominant in the contaminated fermentation after signal pre-processing. Among the five feature extraction parameters, mean was the most optimal, with the highest cumulative variance proportion of 80.94%. PCA analysis revealed a significant cluster separation starting on the 5th day of fermentation.

Keywords: Nata de coco, electronic nose, *Lactobacillus plantarum*, volatile compounds, feature extraction, Principal Component Analysis (PCA)