

ABSTRAK

APLIKASI *PORTABLE LED-BASED FLUORESCENCE SPECTROSCOPY* DAN KEMOMETRIKA UNTUK AUTENTIKASI MADU LEBAH TANPA SENGAT (*Tetragonula laeviceps*)

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Madu *Tetragonula laeviceps* merupakan jenis madu dari lebah madu tanpa sengat yang bermanfaat bagi kesehatan. Namun, produksi yang tidak seimbang dan tingginya permintaan menyebabkan maraknya pemalsuan, umumnya dengan mencampurkan madu asli dengan sirup beras merah (*rice malt syrup*). Penelitian ini bertujuan mengautentikasi madu *Tetragonula laeviceps* menggunakan spektroskopi fluoresensi portabel berbasis LED dan analisis kemometrika.

Pengujian dilakukan dengan tiga sampel yaitu madu murni *Tetragonula laeviceps* nektar *Calliandra calothyrsus* (TL), madu yang dicampur dengan sirup beras (TLC) dalam rasio 10-60%, serta sirup beras murni (SB). Data spektra dianalisis menggunakan metode *Soft Independent Modeling of Class Analogy* (SIMCA) dengan beberapa teknik pretreatment *Smoothing Moving Average* (SMA) dan *Multiplicative Scatter Correction* (MSC). Hasil menunjukkan perbedaan nilai fluoresensi antara madu murni, campuran, dan sirup beras, khususnya pada panjang gelombang 484,5 nm. Model terbaik diperoleh dengan *pretreatment* MSC + SMA 5 *segment*, yang menghasilkan akurasi klasifikasi dan spesifisitas 100%, sensitivitas 0%, serta *error* 0%.

Penelitian ini membuktikan bahwa spektroskopi fluoresensi portabel merupakan metode yang efektif untuk autentikasi madu *Tetragonula laeviceps*, mampu membedakan produk madu asli dan campuran, serta membantu mendeteksi pemalsuan secara cepat, sehingga memberikan perlindungan lebih baik bagi konsumen.

Kata kunci: Madu *Tetragonula laeviceps*, Spektroskopi fluoresensi, Kemometrika, Autentikasi, SIMCA

ABSTRACT

APPLICATION OF PORTABLE LED-BASED FLUORESCENCE SPECTROSCOPY AND CHEMOMETRICS FOR AUTHENTICATION OF STINGLESS BEE HONEY (*Tetragonula laeviceps*)

By

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Tetragonula laeviceps honey, produced by stingless bees, is known for its health benefits. However, the imbalance between limited production and high demand has led to increasing cases of adulteration, commonly by mixing genuine honey with red rice syrup (rice malt syrup). This study aims to authenticate *Tetragonula laeviceps* honey using portable LED-based fluorescence spectroscopy combined with chemometric analysis.

The calibration was conducted on three types of samples: pure *Tetragonula laeviceps* honey from *Calliandra calothyrsus* nectar (TL), honey adulterated with rice syrup (TLC) in ratios ranging from 10% to 60%, and pure rice syrup (SB). Spectral data were analyzed using the Soft Independent Modeling of Class Analogy (SIMCA) method, with several preprocessing techniques including Smoothing Moving Average (SMA) and Multiplicative Scatter Correction (MSC). The results showed clear differences in fluorescence intensity among pure honey, adulterated honey, and rice syrup, particularly at a wavelength of 484.5 nm. The best classification model was obtained using the MSC + SMA (5-segment) preprocessing combination, which achieved 100% classification accuracy and specificity, 0% sensitivity, and 0% error rate.

This research demonstrates that portable fluorescence spectroscopy is an effective method for authenticating *Tetragonula laeviceps* honey. It can distinguish between pure and adulterated products rapidly and non-destructively, thus offering enhanced consumer protection and supporting quality assurance in honey production.

Keywords: *Tetragonula laeviceps* honey, Fluorescence spectroscopy, Chemometrics, Authentication, SIMCA.