DETEKSI PEWARNA MAKANAN PADA BUAH NAGA (*Hylocereus polyrhizus*) DAN SEMANGKA (*Citrullus lanatus*) POTONG SEGAR DENGAN SPEKTROSKOPI *NEAR INFRARED*

INTISARI

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Pemalsuan pada buah potong segar dengan penambahan pewarna sintetis secara illegal merupakan isu penting dalam keamanan pangan. Penelitian ini bertujuan untuk mengidentifikasi adanya penambahan pewarna makanan sintetis pada buah naga merah potong, merah (*Hylocereus polyrhizus*), semangka kuning (*Citrullus vulgaris flavum)* dan merah (*Citrullus vulgaris rubrum*) secara non-destruktif menggunakan teknologi spektroskopi *Near Infrared* (NIR). Selain metode visual dan colormeter berbasis parameter warna L*ab**, pendekatan multivariat menggunakan *Partial Least Squares Regression* (PLSR) dan *Partial Least Square Discriminant Analysis* (PLS-DA) diterapkan untuk menganalisis data spectral NIR.

Pengambilan data dilakukan terhadap sampel buah naga yang direndam dengan larutan pewarna makanan merah buatan dengan konsentrasi 0,5%, 1%, 2%, 3%, 5%, 10%, 20%, dan 50%, serta sampel kontrol tanpa perlakuan. Sebagai pembanding, buah semangka merah dan semangka kuning juga digunakan untuk melihat pola spectral terhadap jenis buah dan warna daging buah. Spektrum NIR dikumpulkan menggunakan alat spectrometer dengan rentang panjang gelombang 1000 – 2000 nm. Data kemudian diproses melalui tahapan *preprocessing*, analisis utama PLSR, dan evaluasi model menggunakan parameter performa seperti koefisien determinasi (R^2), *Root Mean Square Error* (RMSE), dan *residual predictive deviation* (RPD).

Hasil penelitian menunjukkan bahwa model PLSR mampu memprediksi sampel yang mengandung pewarna dengan sampel asli berdasarkan pola spektral dan nilai prediksi yang terbentuk. Nilai $R^2 > 0,70$ dan $SE < 7,00$ menunjukkan tingkat

akurasi dan presisi model yang baik untuk identifikasi kontaminasi pewarna. Metode lanjutan dengan PLS-DA juga mampu mengklasifikasikan kelas-kelas secara akurat antar perlakuan kontrol, konsentrasi menengah, dan tinggi dengan akurasi prediksi > 80%. Dengan demikian pendekatan spektroskopi NIR dikombinasikan dengan PLSR dan PLS-DA terbukti efektif sebagai metode deteksi cepat, non-destruktif, dan berpotensi diterapkan dalam pengawasan mutu buah potong segar.

Kata kunci : *Hylocereus polyrhizus*, *Citrullus vulgaris flavum*, *Citrullus vulgaris rubrum*, pewarna sintetis, *Near Infrared Spectroscopy* (NIR), PLSR, PLS-DA, colormeter, deteksi non-destruktif.

DETECTION OF FOOD COLORS IN DRAGON FRUIT (*Hylocereus polyrhizus*) AND WATERMELON (*Citrullus lanatus*) FRESH-CUT BY NEAR INFRARED SPECTROSCOPE

ABSTRACT

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Adulteration of fresh-cut fruits by illegal addition of synthetic colorants is an important issue in food safety. This study aims to non-destructively identify the addition of synthetic food coloring in fresh-cut red dragon fruit, red (*Hylocereus polyrhizus*), yellow (*Citrullus vulgaris flavum)* and red watermelon (*Citrullus vulgaris rubrum)* using Near Infrared (NIR) spectroscopy technology. In addition to visual and colormeter methods based on Lab* color parameters, a multivariate approach using Partial Least Squares Regression (PLSR) and Partial Least Squares Discriminant Analysis (PLS-DA) was applied to analyze the NIR spectral data.

Data were collected on dragon fruit samples soaked with artificial red food coloring solutions with concentrations of 0.5%, 1%, 2%, 3%, 5%, 10%, 20%, and 50%, as well as control samples without treatment. As a comparison, red watermelon and yellow watermelon were also used to see the spectral pattern of fruit type and pulp color. NIR spectra were collected using a spectrometer with a wavelength range of 1000 - 2000 nm. The data was then processed through preprocessing, main PLSR analysis, and model evaluation using performance parameters such as coefficient of determination (R^2), Root Mean Square Error (RMSE), and residual predictive deviation (RPD).

The results showed that the PLSR model was able to predict samples containing dyes with the original sample based on the spectral pattern and the predicted value formed. The R^2 value > 0.70 and SE < 7.00 indicate a good level of accuracy and precision of the model for dye contamination identification. The

advanced method with PLS-DA was also able to accurately classify classes between control, medium, and high concentration treatments with a prediction accuracy of > 80%. Thus, the NIR spectroscopy approach combined with PLSR and PLS-DA proved to be effective as a rapid, non-destructive detection method, and has the potential to be applied in the quality control of fresh-cut fruits.

Keywords: *Hylocereus polyrhizus*, *Citrullus vulgaris flavum*, *Citrullus vulgaris rubrum*, synthetic dye, Near Infrared Spectroscopy (NIR), PLSR, PLS-DA, colormeter, non-destructive detection.