



PENENTUAN KANDUNGAN PROTEIN TAHU MENGGUNAKAN SPEKTROSKOPI VIS-NIR DAN REGRESI PLS

INTISARI

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Tahu merupakan sumber protein nabati dan asam amino esensial. Tahu juga memiliki kadar air tinggi yang menyebabkannya mudah rusak dan memiliki umur simpan yang singkat. Protein dan kadar air menjadi dua indikator utama mutu tahu, sehingga informasi tentang kandungan keduanya menjadi penting untuk diketahui. Kedua parameter tersebut, secara berurutan, biasanya diukur dengan metode Lowry dan *Thermogravimetri* yang selain membutuhkan waktu dalam preparasi sampelnya, juga merusak. Saat ini banyak dikembangkan analisis kuantitatif dan kualitatif menggunakan teknologi spektroskopi Vis-NIR untuk uji kandungan mutu produk yang lebih murah, cepat, dan tanpa merusak produk. Penelitian ini bertujuan mengetahui kandungan protein dan kadar air tahu putih dengan variasi proporsi kedelai lokal-impor hasil pengujian destruktif, menentukan tingkat prediksi model kalibrasi Vis-NIR untuk pendugaan kandungan protein dan kadar air tahu putih dan memprediksi kandungan protein dan kadar air pada sampel tahu putih produksi Sentra Industri Tahu Krapyak. Sampel yang digunakan berupa tahu putih sebanyak 150 buah yang dibuat lima variasi proporsi kedelai lokal dan impor yang dibuat sendiri dan 10 sampel dari UKM tahu di Krapyak. Data spektra didapatkan dari setiap sampel yang diukur dengan Vis-NIR *Spectroscopy* pada panjang gelombang 400-1000 nm. Sampel prediksi diperoleh dari hasil pengujian kandungan air dan protein secara destruktif menggunakan metode *Thermogravimetri* dan Lowry. Data spektra dianalisis menggunakan regresi *Partial Least Square* (PLS) dengan beberapa *pre-treatment* untuk mengurangi *noise* atau gangguan pada spektra. Hasil pengukuran kandungan protein tahu putih dengan variasi proporsi kedelai lokal-impor secara destruktif yaitu 100% kedelai impor ($13,93 \pm 0,57$)%; 75% kedelai impor + 25% kedelai lokal ($15,52 \pm 0,60$)%; 50% kedelai impor + 50% kedelai lokal ($17,52 \pm 0,47$)%; 25% kedelai impor + 75% kedelai lokal ($18,04 \pm 0,53$)%; dan 100% kedelai lokal ($19,16 \pm 0,42$)%. Model kalibrasi Vis-NIR yang berhasil disusun memiliki tingkat prediksi sangat baik untuk kandungan protein ($R_p^2 = 0,97$; RMSEP= 0,41; RPD= 0,60) dan kadar air ($R_p^2 = 0,90$; RMSEP= 0,47; RPD= 3,44) tahu putih. Sampel tahu putih produksi Sentra Tahu Krapyak, Margoagung, Seyegan, Sleman memiliki kandungan protein yang bervariasi dengan rentang ($13,68 \pm 1,35$ - $17,41 \pm 1,21$)% serta memiliki variasi kadar air dengan rentang ($74,69 \pm 1,80$ - $79,24 \pm 1,61$)%.

Kata Kunci: PLSR, Protein, Tahu, Vis-NIR.



DETERMINATION PROTEIN CONTENT OF TOFU USING VIS-NIR SPECTROSCOPY AND PLS REGRESSION

ABSTRACT

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Tofu is a source of vegetable protein and essential amino acids. However, tofu also has a high moisture content which causes it to break easily and has a short shelf life. Protein and water content are the two main indicators of tofu quality, so information about the content of both is important to know. These two parameters, respectively, are usually measured by the Lowry and Thermogravimetry method which in addition to taking time in sample preparation, are also destructive. Currently, many quantitative and qualitative analyses are developed using Vis-NIR spectroscopy technology for product quality content tests that are cheaper, faster, and without damaging the product. This study aims to determine the protein content and moisture content of white tofu with variations in the proportion of local-imported soybeans resulting from destructive testing, determine the prediction level of the Vis-NIR calibration model for estimating the protein content and water content of white tofu and predict the protein content and water content in white tofu samples produced by the Krapyak Tofu Industry Center. The samples used were 150 pieces of white tofu made by five variations in the proportion of local and imported soybeans made by themselves and 10 samples from tofu SMEs in Krapyak. Spectral data were obtained from each sample measured by Vis-NIR Spectroscopy at wavelengths of 400-1000 nm. Predictive samples were obtained from the results of destructive testing of water and proteint content using Thermogravimetric and Lowry methods. The spectral data obtained were analyzed using Partial Least Square (PLS) regression with several pre-treatments to reduce noise or interference in the spectra. The results of measuring the protein content of white tofu with destructive variations in the proportion of local-imported soybeans are 100% imported soybeans ($13,93 \pm 0,57$)%; 75% imported soybeans + 25% local soybeans ($15,52 \pm 0,60$)%; 50% imported soybeans + 50% local soybeans ($17,52 \pm 0,47$)%; 25% imported soybeans + 75% local soybeans ($18,04 \pm 0,53$)%; and 100% local soybeans ($19,16 \pm 0,42$)%. The successfully constructed Vis-NIR calibration model has a very good predictive rate for protein content ($R_p^2 = 0,97$; RMSEP= 0,41; RPD= 0,60) and moisture content ($R_p^2 = 0,90$; RMSEP= 0,47; RPD= 3,44) white tofu. White tofu samples produced by Sentra Tahu Krapyak, Margoagung, Seyegan, Sleman have protein content that varies with the range ($13,68 \pm 1,35$ - $17,41 \pm 1,21$)% and has a variety of moisture content with a range of ($74,69 \pm 1,80$ - $79,24 \pm 1,61$)%.

Keywords: PLSR, Protein, Tofu, Vis-NIR.