

SIFAT FISIKA DAN MEKANIKA KAYU PANGGAL BUAYA (*Zanthoxylum rhetsa*) PADA ARAH AKSIAL DAN RADIAL SERTA PREDIKSINYA MENGGUNAKAN SPEKTROSKOPI NEAR INFRARED

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INTISARI

Informasi mengenai sifat fisika dan sifat mekanika kayu *Zanthoxylum rhetsa* masih terbatas meskipun kayu ini telah banyak digunakan sebagai bahan baku kerajinan patung. Penelitian ini bertujuan untuk mengetahui sifat fisika dan mekanika *Z. rhetsa* pada kedudukan aksial dan radial, serta prediksi kekuatannya menggunakan spektroskopi *near infrared* (NIR).

Penelitian ini menggunakan kayu *Z. rhetsa* umur 11 tahun dari Kawasan Hutan Dengan Tujuan Khusus (KHDTK) Wanagama. Pengukuran sifat fisika dan mekanika mengacu *British Standard 373: 1957*. Tiap contoh uji diambil dari variasi kedudukan aksial (pangkal, tengah, ujung) dan radial (dekat hati dan dekat kulit). Perekaman spektra NIR dilakukan menggunakan *Fourier Transform Near Infrared* pada *wavenumber* 10.000 – 4.000 cm^{-1} . *Partial Least Square Regression* (PLS-R) digunakan untuk membangun model prediksi berat jenis (BJ), MOR, dan MOE kayu *Z. rhetsa*.

Hasilnya, kadar air basah (KAS) dan kering udara adalah 66,04% dan 15,60%. BJ segar, BJ kering udara (KU), dan BJ kering tanur (KT) masing-masing 0,53; 0,56; dan 0,60. Penyusutan dimensi KU dan KT arah longitudinal, radial, dan tangensial secara berturut-turut adalah 0,17%; 1,40%; 2,53% dan 0,31%; 3,86%; 7,10%. Nilai T/R penyusutan KU dan KT mencapai 2,14 dan 1,94. Nilai keteguhan lengkung statik pada batas proporsi (BP), MOR, dan MOE adalah 476,17; 816,45; dan $91,63 \times 10^3 \text{ kg/cm}^2$. Keteguhan tekan sejajar serat (KTSS) dan tegak lurus serat (KTTLS) adalah 362,28 dan 190,12 kg/cm^2 . Berdasarkan hasil analisis keragaman, kedudukan radial berpengaruh nyata terhadap KAS, penyusutan dimensi KU tangensial, T/R KU dan KT, BP, dan KTSS. Kedudukan aksial berpengaruh nyata terhadap ketiga macam BJ, penyusutan dimensi arah tangensial, MOR, dan KTTLS. Namun, interaksi keduanya tidak memberikan pengaruh nyata. Berdasarkan hasil penelitian, kayu *Z. rhetsa* termasuk dalam kelas kuat II-III dan dapat digunakan sebagai alternatif bahan bangunan non struktural. Model prediksi BJ yang dibangun menggunakan spektroskopi NIR dapat memprediksi BJ dengan cukup baik (nilai R^2 validasi 0,519). Model prediksi MOR dan MOE kurang baik digunakan untuk memprediksi MOR dan MOE karena R^2 validasi yang cukup rendah.

Kata kunci: variasi aksial, variasi radial, sifat fisika, sifat mekanika, *Zanthoxylum rhetsa*, spektroskopi NIR

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PHYSICAL AND MECHANICAL PROPERTIES OF *Zanthoxylum rhetsa* WOOD ON AXIAL AND RADIAL POSITIONS AND ITS PREDICTION USING NEAR INFRARED SPECTROSCOPY

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ABSTRACT

The information about the physical and mechanical properties of *Z. rhetsa* is limited, although it is widely known for sculpture craft material. This study aimed to explore the variation of physical and mechanical properties *Z. rhetsa* wood on both axial and radial positions. Using the latest near-infrared spectroscopy (NIRS) technology, the wood's strength was also predicted.

Using 11 years old *Z. rhetsa* wood from Kawasan Hutan Dengan Tujuan Khusus (KHDTK) Wanagama, the physical and mechanical properties were measured based on British Standard 373: 1957. Each sample was taken from variations in axial (base, middle, top) and radial (near bark and pith) positions. Fourier Transform Near Infrared recorded NIR spectra at wavenumber 10.000 – 4.000 cm⁻¹. Partial Least Square Regression was applied to build predictive model for specific gravity (SG), MOR, and MOE of *Z. rhetsa* wood.

Results showed that the moisture content (MC) of green and air-dried conditions were 66,04% and 15,60%. The value of green, air-dry (AD), and oven-dry (OD) SG were 0,53; 0,56; and 0,60 respectively. The value of AD and OD shrinkage in longitudinal, radial, and tangential directions were 0,17%; 1,40%; 2,53% and 0,31%; 3,86%; 7,10% respectively. The T/R ratio of AD and OD shrinkage were 2,14 and 1,94. Furthermore, the static bending at the proportion limit, MOR, and MOE were 476,17; 816,45; and 91,63 × 10³ kg/cm². The compressive strength (CS) parallel to grain and perpendicular to grain were 362,28 and 190,12 kg/cm². By analysis of variance, axial position significantly affected green MC, tangential AD shrinkage, both AD and OD T/R value, the static bending at the proportion limit, as well as CS parallel to grain. Thus, radial position significantly affected all conditions SG, AD and OD tangential shrinkage, MOR, and CS perpendicular to grain. However, the interaction between the two factors did not show significant effects. The results revealed that the timber was classified in the II-III of strength class and can be applied as an alternative to non-structural building materials. SG prediction model using NIR spectroscopy had moderate performance in forecasting SG since producing adequate R² validation (0,519). Nevertheless, MOR and MOE prediction produced weak models since the R² validation was low.

Keywords: axial variations, radial variations, physical properties, mechanical properties, *Zanthoxylum rhetsa*, NIR spectroscopy

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