Research Article
doi: 10.1590/01047760202531013501
vol(31), 2025

CERNE

Wood properties of *Gordonia fruticosa* and *Vochysia ferruginea*: Anatomical, physical, and colorimetric analysis

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TECHNOLOGY OF FOREST PRODUCTS

ABSTRACT

Background: This study evaluates the anatomical, physical, and colorimetric properties of *Gordonia fruticosa* (huamanchilca) and *Vochysia ferruginea* (bella María), two tropical timber species from the montane rainforest of Amazonas, Peru. Samples were analyzed according to radial and tangential anatomical planes to examine their influence on wood properties under dry and saturated conditions.

Results: Anatomical analysis revealed diffuse porosity in *G. fruticosa* and visible porosity with aliform parenchyma in *V. ferruginea*. Physical tests showed medium basic density values (0.55 and 0.41 g/cm^3, respectively) and similar volumetric shrinkage (~10.8%) in both species. Colorimetric results indicated that drying increases lightness and modifies chromatic coordinates. *G. fruticosa* showed increased red and yellow saturation after drying, whereas *V. ferruginea* exhibited a decrease. No significant differences were found between radial and tangential planes in color parameters.

Conclusion: These findings contribute to understanding the interaction between anatomical features and moisture content on wood properties, providing valuable information for optimizing industrial drying processes and supporting sustainable management of these tropical species.

Keywords: Tropical timber species; Wood anatomy; Wood physical properties; Wood colorimetry; Drying effects.

HIGHLIGHTS

Anatomical, physical, and color traits of *G. fruticosa* and *V. ferruginea* were studied.
Section orientation affects wood color perception in both species.
Moisture content strongly impacts lightness and color saturation.
Drying increases red/yellow in *G. fruticosa*, decreases it in *V. ferruginea*.

ARELLANOS-OCC, R. C.; BACALLA-TENORIO, J.; CASSANA-HUAMÁN, I. A.; PORTAL-CAHUANA, L. A. Wood properties of *Gordonia fruticosa* and *Vochysia ferruginea*: anatomical, physical, and colorimetric analysis. CERNE, v. 31, e103501, 2025. DOI: 10.1590/01047760202531013501

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Scientific Editor: Paulo Ricardo Gherardi Hein

Received: November 05, 2024
Accepted: October 01, 2025

CERNE
ISSN 0104-7760
UNIVERSIDADE FEDERAL DE LAVRAS

INTRODUCTION

Tropical forests, especially those in the Amazon basin, represent one of the largest reservoirs of biodiversity on the planet and constitute a fundamental economic resource for countries such as Peru, where the sustainable exploitation of tropical timber is vital for local and national development (Ferreira et al., 2023; Romero et al., 2024). Despite their importance, many lesser-known commercial species, such as *Gordonia fruticosa* and *Vochysia ferruginea*, lack detailed technological characterizations that allow optimization of their industrial use and promotion of sustainable forest management (Mo, 2024; Moya et al., 2022; Reis et al., 2015).

The anatomical, physical, and colorimetric properties of wood are key determinants of its mechanical performance, dimensional stability, and aesthetic value, factors that directly influence its acceptance in national and international markets (Mo, 2024; Sousa et al., 2019; Vale; et al., 2010). Basic density, for example, is associated with strength and durability, while colorimetry enables an objective assessment of uniformity and visual appeal of the final product, crucial aspects for commercialization (Bonfatti Júnior; Lengowski, 2018; Sousa et al., 2019). Additionally, the anatomical plane of cutting (radial and tangential) affects the physical and optical properties of wood, generating variations in shrinkage and color that must be considered in industrial processes (Dominguez; Cassana; Portal, 2025; Sousa et al., 2019).

Although anatomical differences between species from different families, such as Theaceae (*G. fruticosa*) and Vochysiaceae (*V. ferruginea*), are expected (Reis et al., 2015), it is essential to conduct integrated studies examining how these differences relate to physical and colorimetric properties in dry wood and according to the anatomical cutting plane to improve product handling and quality. Previous studies have shown that proper drying control can reduce color variations, promoting uniformity and commercial value of the wood (Bonfatti; Lengowski, 2018; Mo, 2024; Sousa et al., 2019).

Currently, there is a gap in the literature regarding the joint and systematic characterization of these properties in *G. fruticosa* and *V. ferruginea*, particularly in dry wood and considering specific anatomical planes (radial and tangential). Addressing this gap is crucial to provide scientific information that contributes to optimizing production processes and sustainable management of these tropical species.

Therefore, this study aims to characterize the anatomical features, evaluate the physical properties, and analyze the colorimetric behavior of *Gordonia fruticosa* and *Vochysia ferruginea* in dry wood, considering the influence of radial and tangential anatomical planes. The results seek to provide fundamental information to improve the utilization, conservation, and industrial valorization of these tropical timbers.

MATERIALS AND METHODS

Study Area

The study was conducted in the montane rainforest located in the district of Yambrasbamba, Amazonas, Peru (Figure 1), specifically at the coordinates 5° 36′ 13.7″ S and 77° 59′ 26.7″ W. This location lies within a high montane rainforest, according to the classification by Reátegui and Martínez (2010), at an altitude of 1689 meters above sea level. The climate of the region is classified as Cfb (temperate oceanic climate) according to the Köppen-Geiger system, characterized by moderate temperatures and well-distributed annual rainfall.

The district of Yambrasbamba is distinguished by its complex geomorphology, primarily characterized by high calcareous mountains of Mesozoic origin and mountainous structures belonging to the Ventilla-Quinguiza mountain range, part of the sub-Andean cordillera (Chuquibala, 2022). The predominant vegetation consists of montane cloud forests, along with low forests growing on white sandy soils (Arista et al., 2023). The region's climate is characterized by an average annual temperature of 18.9 °C and an average precipitation of 1247.3 mm (Zepner et al., 2021).

Species Selection and Field Collection

Two forest species were selected for this research: *Gordonia fruticosa* (Schrad.) H. Keng (Theaceae), locally known as "huamanchilca," and *Vochysia ferruginea* Mart. (Vochysiaceae), locally known as "bella María." Three trees per species were selected through convenience sampling following ASTM D5536-18 recommendations for wood sampling (Otzen; Manterola, 2017). Selection criteria included trees in good phytosanitary condition, with straight trunks and free from rot or defects. The trees were botanically identified at the Kuelap Herbarium of the Forestry Engineering School, Toribio Rodríguez de Mendoza National University of Amazonas.

The sampled *G. fruticosa* trees had diameters at breast height (DBH) ranging from 1.25 to 2.95 meters, total heights between 35 and 40 meters, and commercial heights between 23 and 35 meters. The bark was thick and fissured, trunks were straight, and leaves were simple and alternate. Phenologically, *G. fruticosa* specimens presented flowers and leaves at the time of sampling.

The sampled *V. ferruginea* trees had DBH values from 1.43 to 2.28 meters, total heights from 30 to 35 meters, and commercial heights between 15 and 25 meters. Bark was grayish-brown, trunks were long, and leaves were opposite and decussate. Phenologically, *V. ferruginea* was sampled with leaves only, without flowers.

Trees were felled using the destructive method, and logs of 1.30 m length were collected from the mid-trunk region at breast height (approximately 1.30 m from the ground), avoiding sections close to the pith or bark to ensure representative samples (Figure 2). The logs were transported to a carpentry workshop, where they were dimensioned to obtain well-oriented samples for the wood library, extracted according to anatomical planes (radial and tangential).

Laboratory Phase

Macroscopic anatomical studies and organoleptic descriptions were conducted at the Xiloteca Gocta of the Forestry Engineering School, FICA/UNTRM, following the International Association of Wood Anatomists (IAWA, 1989) standards.

Wood samples measuring 10 x 15 x 2.5 cm and 5 x 5 x 5 cm cubes were sanded and polished using sandpapers ranging from 100 to 1000 grit to facilitate detailed observation. Macroscopic anatomical features such as vessel visibility and type, growth rings, parenchyma, rays, and inclusions were examined with a 10x magnifying glass and a stereoscopic microscope. Organoleptic properties including odor, color, sapwood-heartwood transition, taste, and texture were documented.

Physical Properties and Calculations

Physical properties were determined at the Kuelap Herbarium following protocols equivalent to ASTM D4442 (moisture content), ASTM D143 (basic density), and ISO 13061-3 (shrinkage), corresponding to Peruvian Technical Standards NTP N°251.010, NTP N°251.011, and NTP N°251.012 respectively.

Ten well-oriented specimens per species, measuring 3 x 3 x 10 cm, were used. Initial weight and volume were measured; volume was determined by water displacement and weight with a precision balance (± 0.01 g). Samples were oven-dried with a gradual temperature increase from 30°C to 103 ± 2°C, weighed daily until constant weight was reached.

Physical properties including moisture content (MC), basic density (BD), and linear and volumetric shrinkage (shrinkage in longitudinal, radial, and tangential directions) were determined and calculated as follows:

$$MC(\%)\frac{wh - wod}{wod} * 100 \tag{1}$$

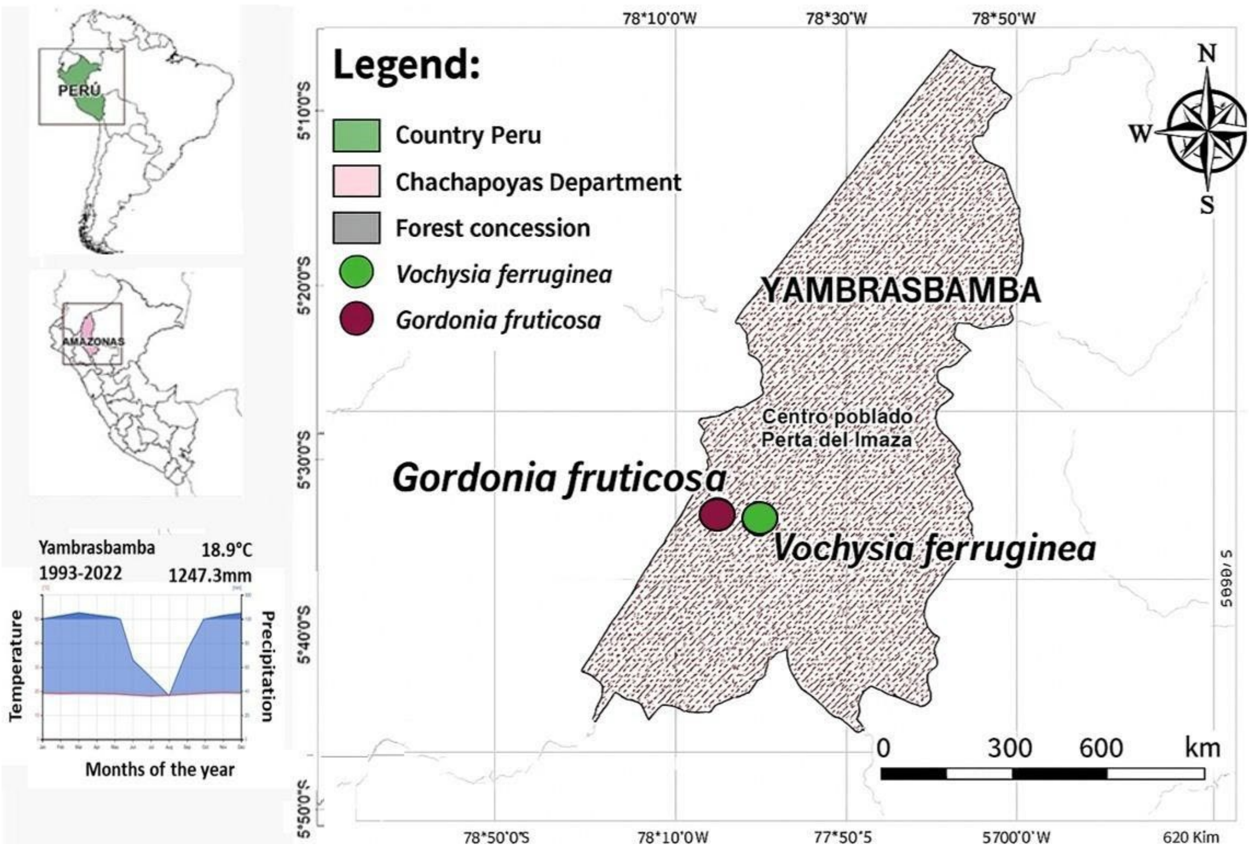

Figure 1: Location of the study area within the high montane rainforest in the district of Yambrasbamba, northeastern Peru. A climate diagram for the period 1993–2022 (Zepner et al., 2021) is presented, with the red line showing the monthly mean temperature, the blue line the mean precipitation, and the blue shaded area the rainy season (>100 mm month-1).

where Wh is the weight of the moist specimen (g) and Wod is the oven-dry weight (g).

$$DB(g/cm^3) = \frac{wod}{Vs} \quad (2)$$

where Vs is the saturated volume (cm^3).

$$Si(\%) = \frac{Ls - Ld}{Ls} * 100 \quad (3)$$

where Ls is the length at saturated condition (cm) and Ld is the length at oven-dry condition (cm).

$$CV(\%) = \frac{Vs - Vo}{Vs} * 100 \quad (4)$$

where Vo is the oven-dry volume (cm^3).

$$Anisotropy\ Coefficient = \frac{STangential}{SRadial} \quad (5)$$

Colorimetry

Colorimetric parameters were determined using wood samples under dry conditions only, as saturated wood is not typically used in structural or finishing applications. For each species (*Gordonia fruticosa* and *Vochysia ferruginea*), 24 samples were prepared and conditioned to equilibrium moisture content before analysis. After preparation, samples were coded and transported to the Food Biotechnology Laboratory of the Faculty of Engineering and Agricultural Sciences (FICA) for analysis.

Color measurements were performed using a Konica Minolta CR-400 colorimeter (Konica Minolta, Tokyo, Japan). Readings were taken on both radial and tangential sections of the dry samples, providing values for Lightness (L*), green-red axis coordinates (a*), and blue-yellow axis coordinates (b*). Additionally, color saturation (C) and hue angle (h*) were calculated using the following equations:

$$C = (a^{*2} + b^{*2})^{\frac{1}{2}}$$

$$h^* = Tang^{-1}\left(\frac{b^*}{a^*}\right)$$

Where:
C = Color saturation of the sample.
h = Hue angle.
a* and b* = are the CIELAB color coordinates.

The hue angle (h*) ranges from 0° for red, 120° for green, and 240° for blue, with intermediate values representing intermediate colors (Sousa et al., 2019). Color saturation was classified according to Vieira et al. (2022), defining 50–100% as highly saturated and 0–50% as low saturated.

The colorimetric characterization followed established protocols in the specialized literature, ensuring accurate representation of the wood's visual properties (Melo et al., 2024; Bonfatti Júnior and Lengowski, 2018). The conversion of CIELAB values to RGB (red, green, blue) was performed using Easy RGB software (https://www.easyrgb.com/en/convert.php#inputFORM), which transforms the data into a three-dimensional Cartesian coordinate system with axes corresponding to the red (R), green (G), and blue (B) channels (https://web.cs.uni-paderborn.de/cgvb/colormaster/web/color-systems/rgb.html). Subsequently, the resulting RGB color codes were interpreted using Encycolorpedia (https://encycolorpedia.com), an online resource that facilitates the identification and description of specific color hues. These tools allowed for a precise and standardized evaluation of the colorimetric data, supporting the objective comparison of the wood species' color characteristics.

Data Analysis

The statistical analysis of the physical and colorimetric properties of *Gordonia fruticosa* and *Vochysia ferruginea* was conducted using a comprehensive approach with R software, version 4.4.2 (R Core Team, 2025). Data transformation and visualization techniques, such as boxplots, were applied to assess the variability and distribution of variables including moisture content, basic density, linear and volumetric shrinkage, and anisotropy coefficient between species. Additionally, Pearson correlation analyses were performed to examine relationships between colorimetric parameters (L*, a*, b*, C, h*) and basic density. Correlation matrices were visualized through correlograms displaying correlation coefficients and statistical significance tests ($p < 0.05$), enabling the identification of meaningful associations and a better understanding of dependencies or independencies among variables. This approach facilitated a thorough and quantitative evaluation of the physical and optical characteristics, providing a robust basis for interpreting the technological properties of the studied species.

RESULTS

Wood Anatomy

General and Macroscopic Characteristics

The wood of *Gordonia fruticosa* and *Vochysia ferruginea* in the air-dry condition exhibited no perceptible odor or distinctive taste. Both species showed slightly differentiated growth rings due to variations in fiber wall thickness, presenting overlapping arc patterns in the tangential section and flecking in the radial section. However, *G. fruticosa* displayed a slightly interlocked grain with a fine texture and high gloss, particularly in the radial section, whereas *V. ferruginea* had a slightly oblique grain with medium texture and medium-high gloss, also more evident in the radial section.

Figure 2: Illustrates the sampling phase and specimen preparation of *Gordonia fruticosa* and *Vochysia ferruginea*. A) shows the measurement of diameter at breast height (DBH). B) depicts the tree felling in the study area. C) corresponds to the marking of the cross-sectional plane for accurate sample extraction, with a detail of the marking shown in the inset. D) displays the processing of samples in the workshop to obtain specimens, with specimen detail in the inset image.

Macroscopic Description

At the macroscopic level, the wood of *Gordonia fruticosa* exhibits pores that are not visible under a 10x magnifying glass, mostly solitary, and occasionally arranged in radial multiples of two or three vessels. The porosity is diffuse, and the parenchyma is apotracheal, not visible under a 10x magnifying glass (Figure 3). The rays are fine and not stratified in the tangential cut, and no inclusions are present. In contrast, the wood of *Vochysia ferruginea* has pores that are visible to the naked eye, mostly solitary, with occasional radial multiples of two, three, or four vessels. The porosity is also diffuse, but the parenchyma is paratracheal, aliform, and confluent, visible under a 10x magnifying glass (Figure 2). The rays are medium-sized, visible under a 10x magnifying glass, and not stratified in the tangential cut. This species contains gum inclusions.

Physical Properties

Table 1 presents the average values of the physical properties of the wood from *Vochysia ferruginea* and *Gordonia fruticosa*, along with the standard deviation and coefficient of variation.

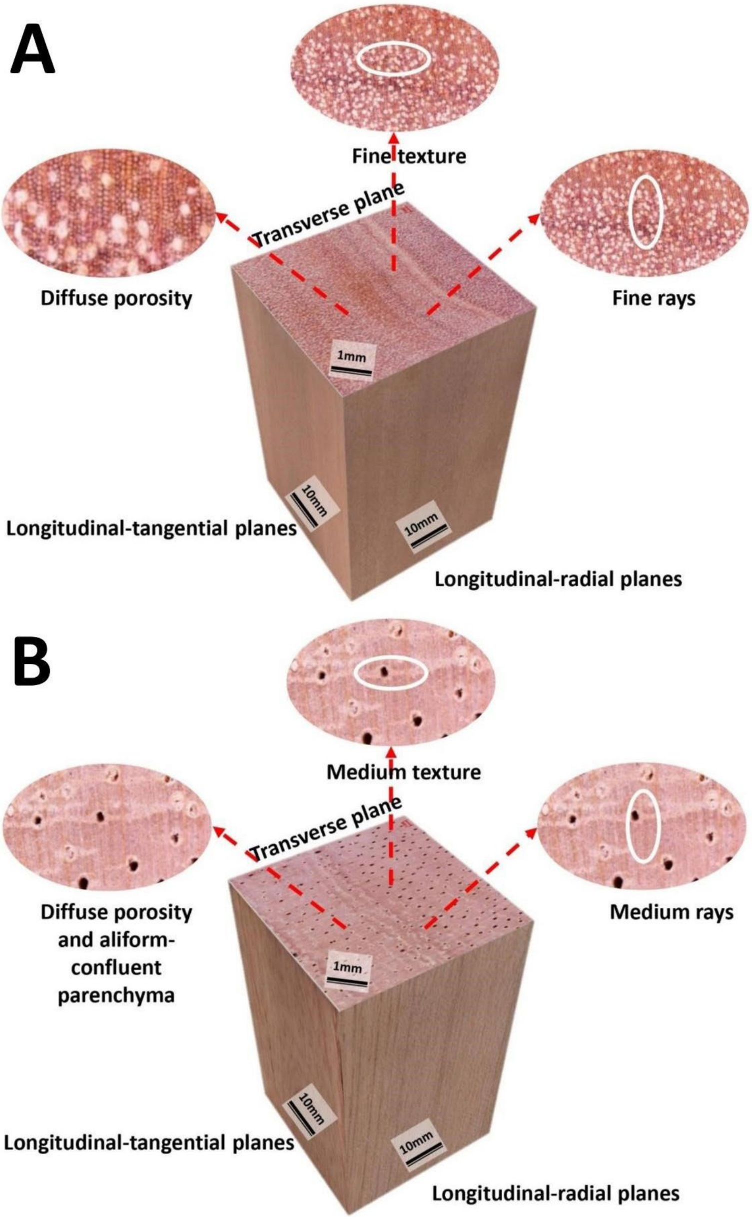

Figure 3: Macroscopic characteristics of *Vochysia ferruginea* Mart. (A) and *Gordonia fruticosa* (Schrad.) H. (B) wood, highlighting their most distinctive features.

Figure 4 complements this data by visually comparing these physical properties through boxplots, highlighting the variation and distribution within each species. Notably, *G. fruticosa* shows higher basic density and anisotropy coefficient values compared to *V. ferruginea*, consistent with the numerical data in Table 02. Both species fall within the medium-density category based on their basic density values, according to the updated classification proposed by Romero et al. (2024), which defines low density as ≤ 0.40 g/cm^3, medium density as 0.41–0.60 g/cm^3, and high density as ≥ 0.61 g/cm^3.

Colorimetry

The CIELAB color parameters (L*, a*, b*, C, h*) were evaluated for *Gordonia fruticosa* and *Vochysia ferruginea* in radial and tangential cuts under dry wood conditions. Table 2 presents the color values for both species according to anatomical section and moisture condition (dry). These results provide important insights into how the optical properties of wood vary depending on anatomical structure and moisture content.

Table 1: Physical properties of the studied species. Values below the mean correspond to the standard deviation, and values in parentheses indicate the coefficient of variation. MC = Moisture Content, BD = Basic Density, LS = Longitudinal Shrinkage, RS = Radial Shrinkage, TS = Tangential Shrinkage, CV = Volumetric Shrinkage and AC= Anisotropy Coefficient.

Species	MC (%)	BD (g/cm³)	LS (%)	RS (%)	TS (%)	CV (%)	AC
G. fruticosa	95.98	0.55	0.23	3.84	6.81	10.88	1.77
		0.33 (5)	0.24 (33)	0.98 (25)	2.61 (30)	2.32 (21)	
V. ferruginea	133.84	0.41	0.26	3.41	7.15	10.83	2.1
		0.05 (13)	0.1 (34)	1.36 (40)	0.24 (32)	3.04 (29)	

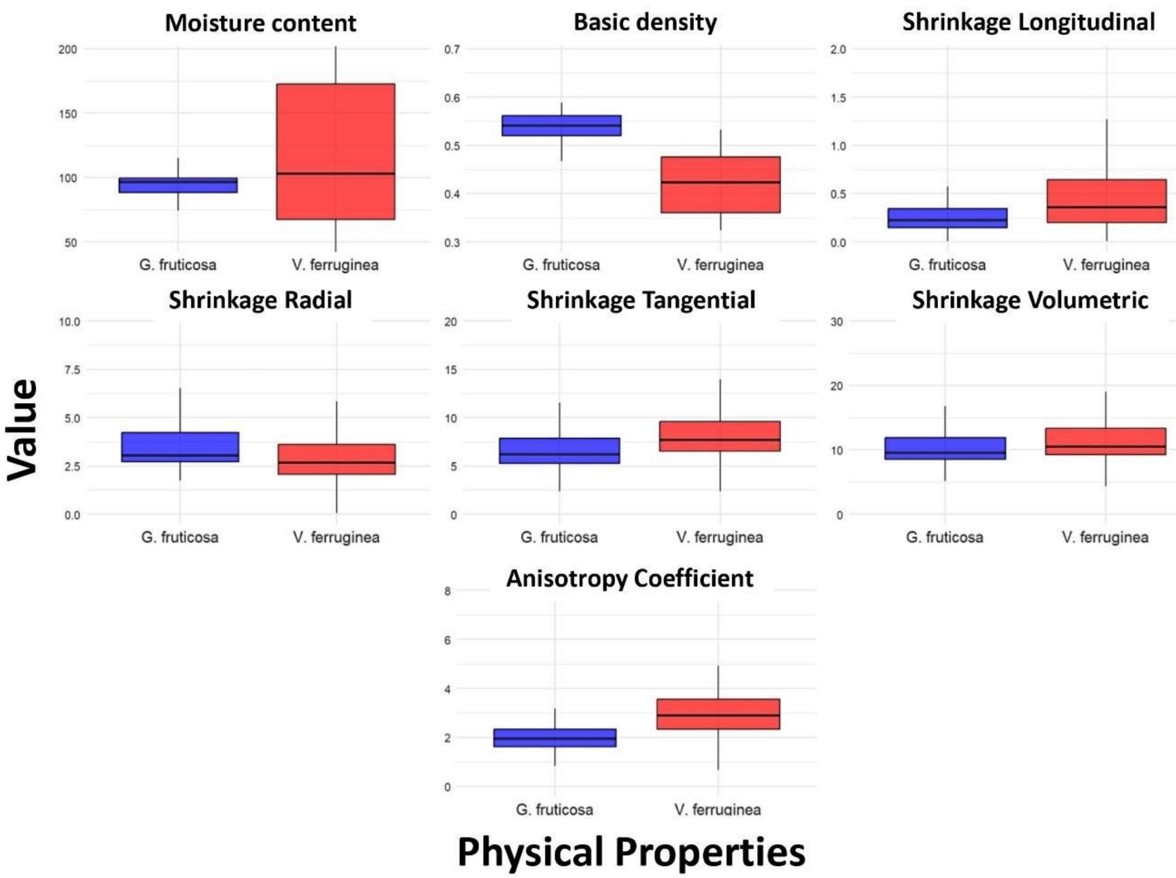

Figure 4: Boxplots comparing the physical properties of *Gordonia fruticosa* and *Vochysia ferruginea*.

Table 2: CIELAB color parameters (L*, a*, b*, C, h*) for *Gordonia fruticosa* and *Vochysia ferruginea* in radial and tangential cuts under "saturated" and "dry" conditions.

Species	Section	Condition	L*	a*	b*	C	h*
G. fruticose	Radial	Dry	63.4	16.3	17.8	24.1	47.5
	Tangential	Dry	62.5	16.5	17.9	24.3	47.1
V. ferruginea	Radial	Dry	68.1	12.3	13.2	18.1	46.9
	Tangential	Dry	67.3	12.3	12.8	17.8	46.2

The colorimetry analysis showed that in *G. fruticosa*, the lightness (L*) values were similar between radial and tangential sections, measuring 63.4 and 62.5 respectively under dry conditions, indicating a relatively light tone in both anatomical orientations. The red component (a*) values were also comparable, with 16.3 in the radial and 16.5 in the tangential section. The yellow component (b*) showed values of 17.8 and 17.9, respectively, contributing to a moderately saturated color with chroma (C) values of 24.1 and 24.3. The hue angles (h*) of approximately 47° in both sections indicate a yellowish tone consistent across anatomical planes.

In contrast, *V. ferruginea* exhibited higher lightness values in the dry condition, with 68.1 for the radial and 67.3 for the tangential sections, reflecting a lighter wood color overall compared to *G. fruticosa*. The a* values were lower (12.3 in both sections), indicating less red saturation, while the b* values (13.2 radial, 12.8 tangential) showed a reduction in yellow saturation relative to *G. fruticosa*. Chroma (C) values of 18.1 and 17.8 and hue angles near 46° further confirmed a less saturated and more neutral color tone.

Both species displayed consistent colorimetric patterns between radial and tangential cuts, with minor differences in lightness and chromatic components. These results highlight that, under dry conditions, wood color parameters remain relatively stable across anatomical planes but vary between species, reflecting intrinsic wood characteristics (Figure 5).

In the Figure 6 illustrates the linear relationships between the CIELAB color parameters (L*, a*, b*) under dry wood condition for the species *G. fruticosa* and *V. ferruginea*. In *G. fruticosa*, the relationship between L* and a* shows a moderate positive correlation (R^2 = 0.4727), indicating that lightness explains some of the variability in the red-green component. The relationship between L* and b* is strong (R^2 = 0.813), reflecting a notable dependence of the yellow-blue component on lightness. Additionally, the correlation between a* and b* is also robust (R^2 = 0.6893), indicating a consistent association between the red-green and yellow-blue components in this species under dry conditions.

In contrast, *V. ferruginea* exhibits very weak correlations between L* and a* (R^2 = 0.0006) and between L* and b* (R^2 = 0.002), suggesting almost no linear relationship between lightness and chromatic components. However, the correlation between a* and b* is moderate (R^2 = 0.3653), indicating some degree of association between the red-green and yellow-blue components in this species when dry.

Overall, these results suggest that color parameter relationships vary considerably between species under dry conditions, reflecting intrinsic differences in wood color behavior independent of moisture content.

Correlation Analysis Between Basic Density and Colorimetric Parameters

The correlation matrices for *Gordonia fruticosa* and *Vochysia ferruginea* (Figure 7) demonstrate strong positive correlations among the CIELAB color parameters (L*, a*, b*, C, h) within each species. For *G. fruticosa*, the luminosity (L*) showed strong correlations with chromatic parameters b* (r = 0.90), C (r = 0.86), and h (r = 0.87), and a moderate correlation with a* (r = 0.69). Additionally, a* and b* exhibited a high correlation (r = 0.83), and similarly, strong correlations were observed among other colorimetric variables.

In *V. ferruginea*, similar strong correlations were observed among color parameters, with L* correlating strongly with b* (r = 0.86), and a* and b* showing a correlation of r = 0.60.

Importantly, the correlation values between basic density and all colorimetric parameters were negligible or absent in both *G. fruticosa* and *V. ferruginea*, indicating that variations in wood density do not appear to influence the colorimetric attributes measured in either species.

These results highlight that while colorimetric parameters are internally consistent and closely related, wood density varies independently from the color characteristics in both *G. fruticosa* and *V. ferruginea*.

DISCUSSION

Wood Anatomy

The anatomical characteristics of *Gordonia fruticosa* and *Vochysia ferruginea* revealed distinct features with practical relevance. *G. fruticosa* exhibits diffuse porosity with solitary vessels, minimal axial parenchyma, fine texture, and interlocked grain, which are associated with its homogeneous structure and high gloss, consistent with observations by (Ferreira et al., 2023; Liang; Baas, 1991). These features suggest potential for uses requiring aesthetically appealing surfaces, such as fine furniture and decorative veneers, where uniform texture and gloss are valued (Ruffinatto et al., 2015). Conversely, *V. ferruginea* shows visible pores and abundant paratracheal parenchyma with gum inclusions, characteristics that can influence permeability and may impact wood durability and finishing properties (León, 2005; Ruffinatto; Crivellaro; Wiedenhoeft, 2015). These anatomical traits imply different processing and application approaches for each species.

Physical Properties

The basic density values of 0.55 g/cm^3 for *G. fruticosa* and 0.41 g/cm^3 for *V. ferruginea* classify both as medium-density woods according to established classifications (Romero et al., 2024). Such densities suggest moderate mechanical strength and moderate weight, important for structural applications where a balance between strength and workability is required (Mo, 2024). The volumetric shrinkage values near 10.8% for both species indicate moderate dimensional changes with moisture loss, which is relevant for drying and seasoning processes to minimize defects (Almeida et al., 2023).

The anisotropy coefficient differs significantly between species, with *V. ferruginea* (2.1) displaying higher anisotropy than *G. fruticosa* (1.77). According to (Luis Christoforo et al., 2016), anisotropy coefficients above 2.0 are considered high and may negatively impact dimensional stability, indicating *V. ferruginea* could be more prone to warping or cracking under drying or use. These findings align with the observed physical behavior and suggest that *G. fruticosa* may be better suited for applications requiring greater dimensional stability.

Wood Colorimetry

The observed variations in colorimetric parameters between *G. fruticosa* and *V. ferruginea*, as well as between their anatomical planes, can be explained by multiple intrinsic factors related to wood chemical composition and microstructure. Although our study did not perform direct chemical characterization such as FTIR-ATR, the literature supports that extractive content, especially phenolic compounds and cellular inclusions, plays a significant role in wood color variation (Bonfatti; Lengowski, 2018; Melo et al., 2024; Santos et al., 2022).

In *G. fruticosa*, drying caused a pronounced increase in lightness (L*) and saturation (C), alongside heightened red (a*) and yellow (b*) tones. This behavior aligns with findings by (Santos et al., 2022) and (Sousa et al., 2019), who attributed similar color intensifications during drying to the oxidation of extractives and phenolic compounds, which intensify reddish-yellow hues. These extractives likely redistribute or chemically alter during moisture loss, affecting chromatic attributes (Dzurenda; Dudiak, 2024). The presence of interlocked grain and fine texture in Gordonia may also influence light reflection, contributing to increased brightness and gloss after drying (Ferreira et al., 2023).

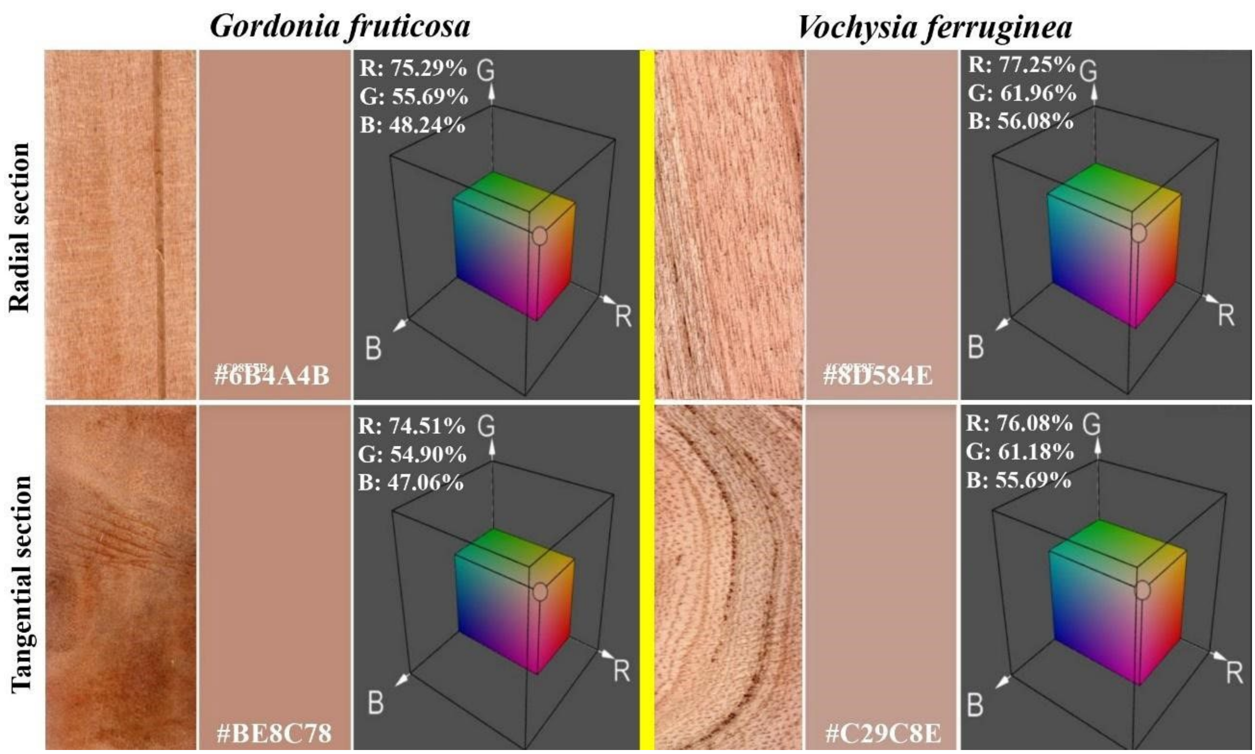

Figure 5: Colorimetry of the two forest species. Radial and tangential sections under dry condition. Color codes and RGB values are also provided. The yellow line divides the two species.

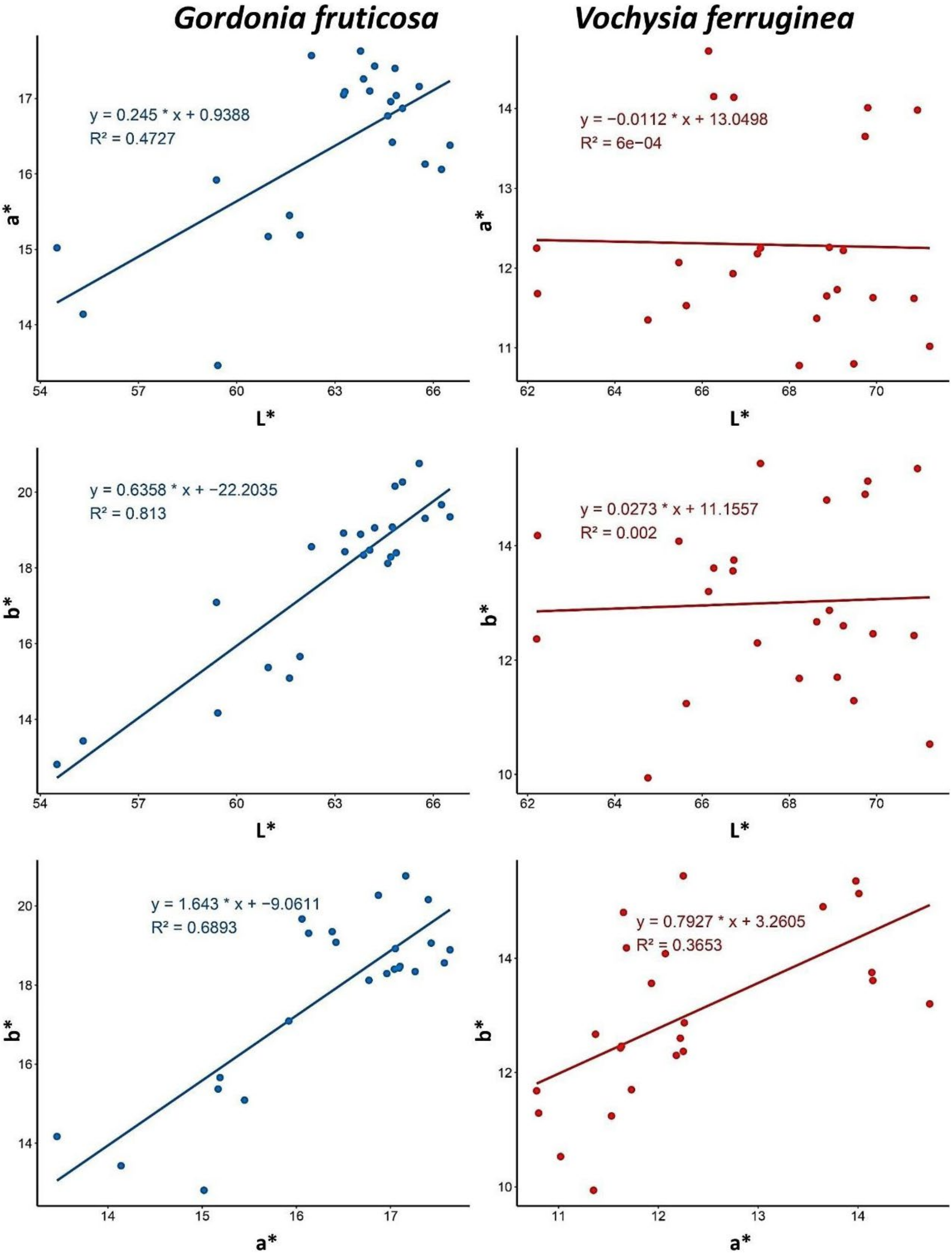

Figure 6: Simple regression analysis of CIELAB parameters (L, a, b*) under dry wood condition for *Gordonia fruticosa* and *Vochysia ferruginea*.

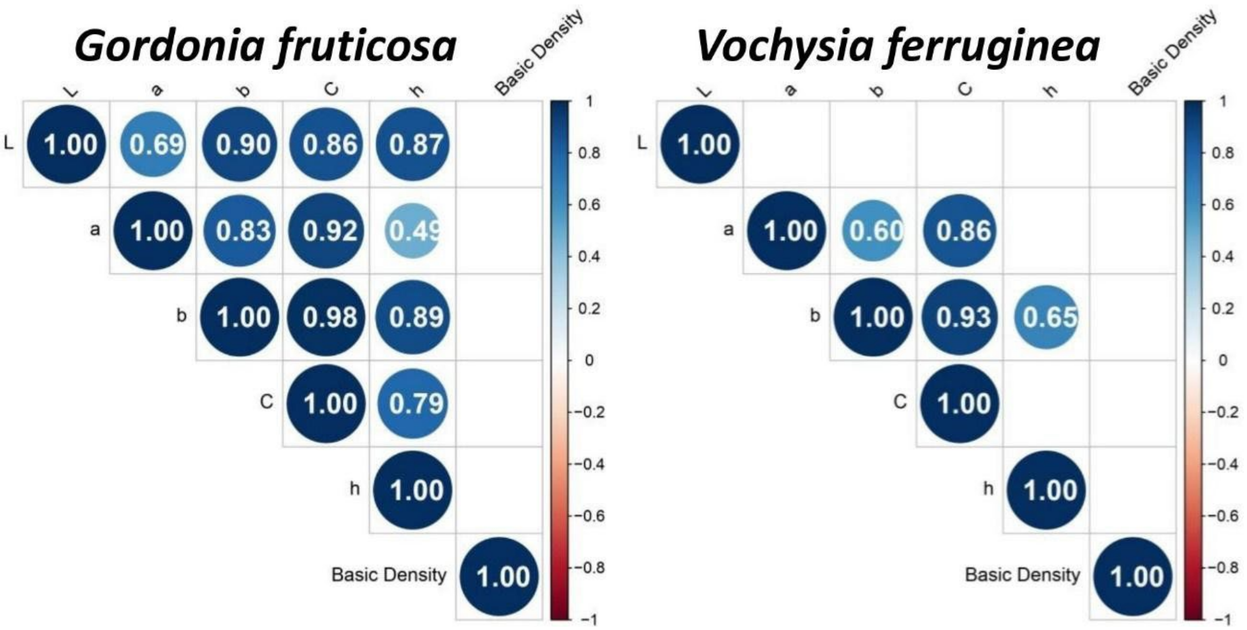

Figure 7: Correlograms showing Pearson correlation coefficients between basic density and CIELAB colorimetric parameters (L, a, b*, C, h) for both species ($p < 0.05$).

Conversely, *V. ferruginea* displayed an increase in lightness with drying but a decrease in chromatic intensity (a*, b*, and C), suggesting a reduction in color saturation. (Vieira et al., 2022) reported similar trends in Fabaceae species, associating color saturation decreases with moisture loss and rearrangement of internal chromophores or cellular inclusions such as gum canals, which are prominent in Vochysia (León, 2005). These anatomical and chemical differences between species explain their contrasting colorimetric responses to drying.

Regarding anatomical planes, no significant differences in color parameters were detected between radial and tangential sections for either species, supporting the idea that anatomical orientation exerts less influence on wood color than moisture content (Arango et al., 2022; Sousa et al., 2019). This finding is consistent with observations that chromatic variations primarily arise from chemical composition and extractive distribution rather than microstructural orientation (Bonfatti and Lengowski, 2018).

These colorimetric variations have practical implications. Color uniformity strongly influences the commercial value and consumer preference for wood products, especially in furniture and decorative applications (Bonfatti and Lengowski, 2018). The pronounced color changes induced by drying highlight the necessity for controlled processing conditions to maintain aesthetic quality, particularly in *G. fruticosa*, where color intensification is notable.

Finally, while direct chemical analyses such as FTIR-ATR were beyond this study's scope, incorporating such data in future work is recommended to deepen understanding of the chemical drivers behind observed colorimetric differences. Additionally, exploring the role of extractives and anatomical inclusions through microscopy and spectroscopy would provide valuable insights to link structural and chemical wood properties with colorimetric behavior.

CONCLUSIONS

This study characterized the anatomical, physical, and colorimetric properties of *Gordonia fruticosa* and *Vochysia ferruginea*, fulfilling the research objectives. Distinct anatomical differences were linked to variations in density and dimensional stability, with *G. fruticosa* showing higher density and lower anisotropy than *V. ferruginea*. Colorimetric analysis under dry conditions revealed species-specific patterns: *G. fruticosa* had increased lightness and red-yellow saturation after drying, while *V. ferruginea* exhibited lighter but less saturated colors. Anatomical cutting planes had no significant effect on color. These findings highlight moisture content's key role in wood color and emphasize controlled drying to maintain color uniformity and enhance commercial value, supporting sustainable management and industrial use of these species.

AUTHORSHIP CONTRIBUTION

Project Idea: RCAO; JBT; IACH; LAPC

Funding: RCAO; JBT

Database: RCAO; JBT; LAPC

Processing: RCAO; JBT

Analysis: RCAO; JBT; IACH; LAPC

Writing: LAPC

Review: RCAO; JBT; IACH; LAPC

DATA AVAILABILITY

The datasets supporting the conclusions are included in the article.

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