HOLOS
ISSN 1807 - 1600

CHARACTERIZATION OF *Corymbia citriodora* WOOD FOR CONSTRUCTION

M. C. J. A. NOGUEIRA[1], J. S. VASCONCELOS[2], V. A. DE ARAUJO[3], A. L. CHRISTOFORO[4], F. A. R. LAHR[5]
Universidade Federal do Mato Grosso (UFMT)[1], Universidade Estadual Paulista (UNESP)[2], Grupo de Pesquisa em Desenvolvimento de Produtos Lignocelulósicos (LIGNO)[3], Universidade Federal de São Carlos (UFSCar)[4], Universidade de São Paulo (USP)[5]
ORCID ID: http://orcid.org/0000-0002-3510-8498[5]
frocco@sc.usp.br[5]

Submetido 17/07/2020 - Aceito 12/02/2021

DOI: 10.15628/holos.2021.10747

ABSTRACT

The essences from sylviculture have been used for pulp and paper and charcoal industry. Hence, value-added examples for construction are essential. However, this use needs to be ensured by criteria prescribed by technical standards such as ABNT NBR 7190 (1997) used here. The present paper evaluated *Corymbia citriodora* wood to promote the effective construction use through the material characterization. Thus, fourteen mechanical properties and two physical properties were estimated. Changes in the property values under moisture content reduction were observed at two conditions: the initial at 30% and the standard point at 12%, according to prescriptions of this cited technical standard. In total, 2189 repeats were carried out in this document. Seven properties showed visible improvements and influences in the resistance from the observed moisture reduction: perpendicular and parallel compression values and static bending in the modulus of rupture, parallel tensile in the modulus of elasticity, and strength properties of shear stress, tangential cleavage and toughness. Mechanically, *Corymbia citriodora* wood can be applied efficiently for civil construction, since these results followed the trends pointed out by literature.

KEYWORDS: Lemon-scented Gum, timber, moisture content, density, resistance.

CARACTERIZAÇÃO DA MADEIRA DE *Corymbia citriodora* PARA A CONSTRUÇÃO

RESUMO

As essências da silvicultura têm sido utilizadas para as indústrias de polpa de celulose e papel e carvão vegetal. Por isso, exemplos de valor agregado para a construção são essenciais. Porém, esse uso precisa ser garantido por critérios prescritos por normas técnicas, tais como a ABNT NBR 7190 (1997) utilizada aqui. O presente artigo avaliou a madeira de *Corymbia citriodora* para promover o seu efetivo uso construtivo mediante a caracterização do material. Assim, quatorze propriedades mecânicas e duas propriedades físicas foram estimadas. Alterações nos valores das propriedades sob a redução do teor de umidade foram observadas em duas condições: a inicial a 30% e o ponto padrão a 12%, segundo as prescrições dessa norma técnica citada. No total, 2189 repetições foram conduzidas neste documento. Sete propriedades mostraram visíveis aumentos e influências na resistência a partir da redução da umidade: compressões normal e paralela e flexão estática no módulo de ruptura, tração paralela no módulo de elasticidade e as propriedades de cisalhamento, fendilhamento tangencial e tenacidade. Mecanicamente, a madeira de *Corymbia citriodora* pode ser aplicada eficientemente para construção civil, visto que esses resultados seguiram as tendências apontadas pela literatura.

PALAVRAS-CHAVE: eucalipto-limão, madeira, teor de umidade, densidade, resistência.

1 INTRODUCTION

Brazil has the fourth largest industrial park for sawmilling in the world (TAVARES & TAVARES, 2015). From this relevant potential, the domestic construction sector can increase the consumption of sawmilled products based on sylviculture resources. In that context, lumber-based products with structural features are still undervalued on the national market.

Among the silvicultural essences, *Corymbia citriodora* is a widespread forest species in Brazil, particularly, due to its wide range of uses, from wood to leaves (SILVA et al., 2012). This species is endemic to Australian region of Queensland, which is one of the better varieties for cultivation at lower latitudes of the subtropics and tropics, but not in equatorial regions (CABI, 2013); however, this forestry essence is commonly found worldwide (GUTIÉRREZ, 1976).

Citriodora genus has excellent form, with well-shaped crown with sparse foliage, whose purpose is applied for non-wood forest products – notably, for lemon-scented essential oil – since this multipurpose tree can be grown profitably by farmers with smallholdings (CABI, 2013). Spotted Gum is another standard trade common name for this species (ASANTE et al., 2001; MARASENI et al., 2009). Citriodora essential oil is used both *in natura* for the room aromatization and in the production of essences, perfumes, disinfectants, soaps, and detergents (SILVA et al., 2012). *Corymbia citriodora* is the right designation for '*Eucalyptus citriodora*' species, because a taxonomic revision of bloodwoods – including ghost gum trees – was considered from newer phylogenetic analyses (HILL & JOHNSON, 1995). In a global context, this forestry species has been intensively studied to replace native essences and/or exotic varieties with slower growth.

A medium-sized to large, *Corymbia citriodora* is a straight-stemmed tree with 25 to 40 meters tall, with smooth, pale grey, cream or pink powdery bark throughout, decorticating in flakes (CABI, 2013).

Corymbia citriodora timber is reddish light brown in colour with dark veins and straight grain (GUTIÉRREZ, 1976), which is paler and lighter, but with a scarce red pigment (GARCIA et al., 2014). Dimensional stability of this wood has been considered excellent in terms of anisotropic coefficient (LOURENÇON et al., 2013). Mechanical and aesthetical features has justified the broad utilization of citriodora wood in Brazil (BISSOLI-DALVI et al., 2017).

Lemon-scented Gum produces strong wood suitable for fuelwood, charcoal, posts, poles, household products, boats (CABI, 2013), general construction materials, sawn timber, light and heavy buildings, plywood panels, tool handles (GUTIÉRREZ, 1976), and cellulose and paper (SEVERO et al., 2013). Despite eucalypt retractions and, consequently, small defects in "wood-mud" interfaces, Folz & Ino (2012) still suggested that citriodora round-logs could be applied for single-family housing based on mixed building techniques. Citriodora should be better utilized for construction, since De Araujo et al. (2020) measured a high level of carbon fixation by this wood.

Comparing to *Eucalyptus cloeziana* and *E. dunnii*, Borges & Moreschi (2013) disclosed the *Corymbia citriodora* was the most efficient wood species for cross-arms on utility poles, reaching

HOLOS ISSN 1807 - 1600

noticeable performances in different tests under economic and functional considerations such as damage analyses, static bending and penetration of wood preservation.

Specific studies approached different tests with respect to *Corymbia citriodora* properties such as thermal (PINTO & CALIL JUNIOR, 2005; PAULA et al., 2014; PAES et al., 2015), mechanical (CHRISTOFORO et al., 2014; ZANGIÁCOMO et al., 2014), physical (LOURENÇON et al., 2013; MELO et al., 2015; DELUCIS et al., 2016), anatomical (REDMAN et al., 2011; DILLON et al., 2012), and chemical evaluations (SEVERO et al., 2006; SILVA et al., 2015b). But, a complete characterization in the mechanical perspective is still required to increase citriodora potentialities in construction.

This paper investigated physical-mechanical properties of *Corymbia citriodora* wood at two moisture contents (30 and 12%), according to the prescriptions of the ABNT NBR 7190 (1997) and t-test statistical support to highlight the effective potentials of this species for construction.

2 MATERIALS AND METHODS

2.1 Materials

For a representative characterization, wood samples were randomly collected through different forest areas and conditions (regions, ages, and diameters). *Corymbia citriodora* trees were originated from eight cities from the São Paulo state, whose details are showed in Table 1.

Table 1: Details of *Corymbia citriodora* wood samples.

Log Amount	Beam Amount per Log	Age	Diameter (m)	City Region
1	2	16	0.180	Rio Claro
2	3	16	0.185	Rio Claro
3	2	16	0.190	Rio Claro
4	2	28	0.235	Corumbataí
5	1	28	0.235	Corumbataí
6	5	28	0.280	Corumbataí
7	2	28	0.260	Corumbataí
8	2	28	0.265	Corumbataí
9	6	28	0.310	Manduri
10	4	28	0.250	Manduri
11	4	28	0.250	Manduri
12	4	28	0.240	Manduri
13	5	28	0.400	Camaquã
14	2	28	0.310	Camaquã
15	4	41	0.225	Itirapina
16	4	41	0.210	Itirapina
17	3	19	0.210	Rio Claro
18	2	19	0.210	Rio Claro
19	2	28	0.480	Pradópolis
20	2	28	0.535	Pradópolis
21	2	50	0.510	Pradópolis
22	6	42	0.410	Bebedouro
23	5	28	0.280	Restinga
24	2	28	0.255	Restinga

2.2 Methods

This study was developed using the same script and methodology followed by similar approaches for other different eucalypt characterizations – for example, Lahr et al. (2017; 2018) and Nogueira et al. (2018a,b,c; 2019a,b; 2020). This strategy respected the same procedures and allowed a standardized path for comparisons and discussions.

Thus, sixteen properties were considered to characterize the selected wood (*Corymbia citriodora*), whose test descriptions and requirements were prescribed by the ABNT NBR 7190 (1997) standard document to analyze:

- Two physical tests at 30% and 12% moisture content:
    - Volumetric mass and bulk densities;
- Fourteen mechanical tests at 30% and 12% moisture content:
    - Five modulus of rupture:
        - Parallel and perpendicular compression to grain, parallel and perpendicular tensile to grain, and static bending;
    - Four modulus of elasticity:
        - Parallel and perpendicular compression to grain; parallel tensile to grain, and static bending;
    - Other five strength resistances:
        - Parallel and perpendicular hardness, shear stress, cleavage, and toughness.

The result presentation was organized with accordance to Lahr's and Nogueira's studies. For each studied property, the statistical analysis was supported by t-test at 5% of significance. All evaluations were performed using the Excel program from Microsoft Office 2016.

3 RESULTS AND DISCUSSIONS

Four tables demonstrated the test results and respective statistical analysis for densities, modulus of rupture, modulus of elasticity, and other strength properties. About 60 repeats per studied property were carried out, which totalized 2189 repeats. This broad sampling and distinct sources of wood samples described in the Table 1 contributed to a more representative analysis.

From the moisture content reduction, the bulk density decreased 0.13 g/cm^3 in relation to this moisture difference at two conditions (30% initial, and 12% final). By the t-test analysis, the null hypothesis of mean equality was rejected for the bulk density (Table 2) – that is, a significant difference was verified when the moisture content was reduced from 30 to 12% (P-value < 0.05).

Regardless of moisture changes, the volumetric mass density was about 0.8 g/cm^3. While this study considered randomized samples with different ages, log diameters and origins (Table 1), the volumetric mass density was close to average means obtained by Lourençon et al. (2013) for 60-year citriodora logs from Rio Grande do Sul state. Using Coradin et al. (2016) and Silva et al. (2015a) standards, this physical property classified the *Corymbia citriodora* as a hardwood.

Table 2: Results for wood density of *Corymbia citriodora*.

Property	MC (%)	M	sd	P-value
Bulk Density (g/cm³)	30	1.13	0.11	0.0000
	12	1.00	0.13	
Volumetric Mass Density (g/cm³)	12	0.78	0.09	-

MC: moisture content; M: mean of studied property; sd: standard deviation

In modulus of rupture (Table 3), all properties were increased with the moisture decrease from 30 to 12% such as parallel compression (7.3 MPa), perpendicular compression (1.3 MPa), parallel tensile (9.4 MPa), perpendicular tensile (0.2 MPa), and static bending (14.9 MPa). From this moisture reduction, parallel and perpendicular tensile values did not reveal influences in the means as identified by t-test. In contrast, other three rupture properties presented influences.

Table 3: Results for modulus of rupture of *Corymbia citriodora*.

Property	MC (%)	M	sd	P-value
Parallel Compression (MPa)	30	54.8	10.4	0.0012
	12	62.1	14.8	
Perpendicular Compression (MPa)	30	5.1	3.4	0.0309
	12	6.4	3.6	
Parallel Tensile (MPa)	30	114.2	44.2	0.1942
	12	123.6	39.5	
Perpendicular Tensile (MPa)	30	3.7	1.3	0.4661
	12	3.9	1.7	
Static Bending (MPa)	30	109.6	23.8	0.0013
	12	124.5	29.2	

MC: moisture content; M: mean of studied property; sd: standard deviation

With this moisture content decrease (from 30% to 12%, Table 4), the modulus of elasticity showed decreases in a property (78.7 MPa in parallel compression) and increases in other three properties (114.2 MPa in perpendicular compression, 2685.3 MPa in parallel tensile and 1172.3 MPa in static bending). As confirmed by t-test, three properties (static bending, perpendicular and parallel compressions) did not show influences in their means with this moisture reduction. In this evaluation, only the parallel tensile revealed an influence (P-value < 0.05).

Table 4: Results for modulus of elasticity of *Corymbia citriodora*.

Property	MC (%)	M	sd	P-value
Parallel Compression (MPa)	30	18192.7	4654.5	0.9321
	12	18114.0	5942.0	
Perpendicular Compression (MPa)	30	512.7	344.7	0.0503
	12	626.9	333.8	
Parallel Tensile (MPa)	30	19198.7	5657.9	0.0098
	12	21884.0	6293.8	
Static Bending (MPa)	30	18145.5	4121.8	0.1381
	12	19317.8	5071.5	

MC: moisture content; M: mean of studied property; sd: standard deviation

For other resistances, three properties increased with moisture changes (3.1 MPa in shear stress, 0.07 MPa in tangential cleavage, and 2.0 N.m in toughness), and two properties decreased in the same observation (0.15 kN in parallel hardness and 0.55 kN in perpendicular hardness). By t-test, this analysis suggested that hardness values did not present influences in their means. The statistical analysis showed the rejection of the null hypothesis of mean equality for shear stress, tangential cleavage and toughness – in other words, they showed significant differences in their means with the moisture reduction (P-value < 0.05) (Table 5).

Table 5: Results for other strength properties of *Corymbia citriodora*.

Property	MC (%)	M	sd	P-value
Shear Stress (MPa)	30	14.90	3.50	0.0000
	12	18.00	4.00	
Tangential Cleavage (MPa)	30	0.90	0.20	0.0098
	12	0.97	0.10	
Perpendicular Hardness (kN)	30	11.33	7.60	0.6271
	12	10.78	5.58	
Parallel Hardness (kN)	30	10.05	8.97	0.7840
	12	9.90	3.00	
Toughness (N.m)	30	19.30	6.00	0.0444
	12	21.30	5.40	

MC: moisture content; M: mean of studied property; sd: standard deviation

Comparing to other studies about similar broad characterization of eucalypt varieties – for example, Lahr et al. (2017; 2018) and Nogueira et al. (2018a,b,c; 2019a,b; 2020) – those results obtained (Tables 2 to 5) suggested that *Corymbia citriodora* wood species was fully superior to alba and grandis essences and was somewhat inferior in some mechanical properties to saligna, camaldulesis, umbra, tereticornis, urophylla and maidenii. Still in this comparison, wood density of citriodora was visibly greater than alba, camaldulensis, grandis, saligna, umbra and urophylla as well as citriodora was also slightly greater than maidenii and tereticornis woods.

The suggestion of *Corymbia citriodora* wood in construction was already claimed by Folz & Ino (2012) for single-family housing, particularly, through the production of a house concept. In addition, Salcedo et al. (2012) suggested good potentials in carbon sequestration as timber for durable purposes. All authors cited and those efficient results in mechanical properties obtained in this present study emphasized the evident potential of citriodora species for structural uses.

This statement could be better supported by additional studies on the wood preservation of *Corymbia citriodora* to solve drying problems in lumber production and decay in structural parts under permanent exposure in outdoor spaces. These research initiatives could reinforce the great potentiality evinced by relevant mechanical properties identified by this present study.

4 CONCLUSIONS

In the physical characterization of *Corymbia citriodora* wood, the bulk density indicated a slightly decrease level, particularly, when the moisture content was reduced from 30 to 12%. This species was characterized as a high density wood by means of some literature parameters.

Regarding mechanical properties of *Corymbia citriodora* wood, only parallel compression in the modulus of elasticity and two hardness strengths (parallel and perpendicular) showed decreases from the moisture reduction. On the other hand, other eleven properties revealed perceptible increases in this studied condition.

Statistically, seven out of fourteen mechanical properties showed modifications in their resistance values when they were submitted to the moisture reduction, that is, three properties in the modulus of rupture (parallel and perpendicular compressions, and static bending), parallel tensile in the modulus of elasticity, and other three resistance properties (shear stress, tangential cleavage, and toughness).

Therefore, good results for mechanical resistance evinced that *Corymbia citriodora* wood can be applied for structural purposes in construction, being in accordance with former studies.

5 REFERENCES

ABNT – ASSOCIAÇÃO BRASILEIRA DE NORMAS TÉCNICAS. (1997). *NBR 7190 - Projeto de estruturas de madeira*. Rio de Janeiro: ABNT.

ASANTE, K. S.; BROPHY, J. J.; DORAN, J. C.; GOLDSACK, R. J.; HIBBERT, D. B.; LARMOUR, J. S. (2001). A comparative study of the seedling leaf oils of the spotted gums: species of the *Corymbia* (Myrtaceae), section Politaria. *Australian Journal of Botany*, 49(1), 55-66.

BISSOLI-DALVI, M.; FERRES, S. C.; ALVAREZ, C. E.; FUICA, G. E. S. (2017). Avaliação da sustentabilidade da madeira por meio da ferramenta ISMAS. *Floresta e Ambiente*, 24, 1-7.

BORGES, C. C.; MORESCHI, J. C. (2013). Potencialidade do uso de cruzetas de madeira tratada no Brasil. *Floresta*, 43(2), 313-326.

CABI. (2013). *The CABI encyclopedia of forest trees*. London: CPi Group. 532 pp.

CHRISTOFORO, A. L.; PANZERA, T. H.; SILVA, D. A. L.; FIORELLI, J.; LAHR, F. A. R. (2014). Shear and Longitudinal Modulus of Elasticity in Structural lumber beams. *International Journal of Materials Engineering*, 4(1), 31-36.

CORADIN, V. T. R.; CAMARGOS, J. A. A.; PASTORE, T. C. M.; CHRISTO, A. G. *Madeiras comerciais do Brasil*: chave interativa de identificação baseada em caracteres gerais e macroscópicos. 2016.

DE ARAUJO, V.; VASCONCELOS, J.; CORTEZ-BARBOSA, J.; MORALES, E.; CHRISTOFORO, A.; GAVA, M.; LAHR, F.; GARCIA, J. (2020). Wood consumption and fixations of carbon dioxide and carbon from timber housing techniques: A Brazilian panorama. *Energy & Buildings* 216, 1-14.

DELUCIS, R. A.; CADEMARTORI, P. H. G.; MISSIO, A. L.; GATTO, D. A. (2016). Decay resistance of four fast-growing eucalypts wood exposed to three types of fields. *Maderas Ciencia y Tecnología*, 18(1), 33-42.

DILLON, S. K.; BRAWNER, J. T.; MEDER, R.; LEE, D. J.; SOUTHERTON, S. G. (2012). Association genetics in *Corymbia citriodora* subsp. variegata identifies single nucleotide polymorphisms affecting wood growth and cellulosic pulp yield. *New Phytologist* 195(3), 596-608.

FOLZ, R. R.; INO, A. (2012). Estrutura de eucalipto roliço e o subsistema de vedação de residência unifamiliar. *Floresta e Ambiente*, 19(2), 210-218.

GARCIA, R. A.; OLIVEIRA, N. S.; NASCIMENTO, A. M.; SOUZA, N. D. (2014). Colorimetria de madeiras dos gêneros *Eucalyptus* e *Corymbia* e sua correlação com a densidade. *Cerne*, 20(4), 509-517.

GUTIÉRREZ, G. L. (1976). *Atlas del eucalipto. información y ecologia*. v. 1, Seville: INIA-ICONA. 140 pp.

HILL, K. D.; JOHNSON, L. A. S. (1995). Systematic studies in the eucalypts. A revision of the bloodwoods, genus *Corymbia* (Myrtaceae). Telopea, 6(2/3), 185-504.

LAHR, F. A. R.; NOGUEIRA, M. C. J. A.; DE ARAUJO, V. A.; VASCONCELOS, J. S.; CHRISTOFORO, A. L. (2018). Wood utilization of *Eucalyptus grandis* in structural elements: densities and mechanical properties. *Engenharia Agrícola*, 38, 642-647.

LAHR, F. A. R.; NOGUEIRA, M. C. J. A.; DE ARAUJO, V. A.; VASCONCELOS, J. S.; CHRISTOFORO, A. L. (2017). Physical mechanical characterization of *Eucalyptus urophylla* wood. *Engenharia Agrícola*, 37, 900-906.

LOURENÇON, T.; GATTO, D.; MATTOS, B.; DELUCIS, R. (2013). Propriedades físicas da madeira de *Corymbia citriodora* no sentido radial. *Scientia Forestalis*, 41(99), 369-375.

MARASENI, T. N.; COCKFIELD, G.; MAROULIS, J. (2009). An assessment of silvipasture potential in Southeast Queensland, Australia. *Australasian Journal of Regional Studies*, 15(3), 297-310.

MELO, L. E. L.; SILVA, J. R. M.; NAPOLI, A.; LIMA, J. T.; NASCIMENTO, D. F. R. (2015). Influence of anatomy and basic density on specific cutting force for wood from *Corymbia citriodora* Hill & Johnson. *Forest Systems*, 24(3), 1-9.

NOGUEIRA, M. C. J. A.; ALMEIDA, D. H.; VASCONCELOS, J. S.; ALMEIDA, T. H.; ARAUJO, V. A.; CHRISTOFORO, A. L.; LAHR, F. A. R. (2018a). Properties of Eucalyptus umbra wood for timber structures. *International Journal of Materials Engineering*, 8(1), 12-15.

NOGUEIRA, M. C. J. A.; ALMEIDA, D. H.; DE ARAUJO, V. A.; VASCONCELOS, J. S.; CHRISTOFORO, A. L.; ALMEIDA, T. H.; LAHR, F. A. R. (2019a). Physical and mechanical properties of *Eucalyptus saligna* wood for timber structures. *Ambiente Construído*, 19(2), 233-239.

NOGUEIRA, M. C. J. A.; DE ARAUJO, V. A.; VASCONCELOS, J. S.; CHRISTOFORO, A. L.; LAHR, F. A. R. (2020). Sixteen properties of *Eucalyptus tereticornis* wood for structural uses. *Bioscience Journal*, 36, 449-457.

NOGUEIRA, M. C. J. A.; DE ARAUJO, V. A.; VASCONCELOS, J. S.; CRUZ, J. N.; VASCONCELOS, J. C. S.; PRATAVIERA, F.; CHRISTOFORO, A. L.; LAHR, F. A. R. (2018b). Characterization of *Eucalyptus*

maidenii timber for structural application: physical and mechanical properties at two moisture conditions. *South-east European Forestry*, 9(2), 1-6.

NOGUEIRA, M. C. J. A.; DE ARAUJO, V. A.; VASCONCELOS, J. S.; GUTIÉRREZ-AGUILAR, C. M.; CRUZ, J. N.; VASCONCELOS, J. C. S.; PRATAVIERA, F.; CHRISTOFORO, A. L.; LAHR, F. A. R. (2018c). Caracterización físico-mecánica de la madera de *Eucalyptus camaldulensis* para uso estructural proveniente de Restinga, Brasil. *Revista Forestal de Peru*, 33(1), 52-62.

NOGUEIRA, M. C. J. A.; DE ARAUJO, V. A.; VASCONCELOS, J. S.; PRATAVIERA, F.; VASCONCELOS, J. C. S.; CRUZ, J. N.; CHRISTOFORO, A. L.; LAHR, F. A. R. (2019b). Propriedades físico-mecânicas da madeira de *Eucalyptus alba* para construção civil. *Ciência da Madeira*, 10(1), 71-77.

PAES, J. B.; SEGUNDINHO, P. G. A.; EUFLOSINO, A. E. R.; SILVA, M. R.; CALIL JUNIOR, C.; OLIVEIRA, J. G. L. (2015). Resistance of thermally treated woods to *Nasutitermes corniger* in a food preference test. *Madera y Bosques*, 21(1), 157-164.

PAULA, M. O.; LOIOLA, P. L.; MOREIRA, G. R.; SEGUNDINHO, P. G. A. (2014). Análise termomecânica da madeira de *Corymbia citriodora* submetida a gradientes térmicos. *Floresta e Ambiente*, 21(3), 358-368.

PINTO, E. M.; CALIL JUNIOR, C. (2005). Determinação da taxa de carbonização de vigas estruturais de *Eucalyptus citriodora* e *Eucalyptus grandis*. *Revista Sul-Americana de Engenharia Estrutural*, 2, (3), 63-77.

REDMAN, A. L.; BAILLERES, H.; PERRÉ, P. (2011). Characterization of viscoelastic, shrinkage and transverse anatomy properties of four Australian hardwood species. *Wood Material Science & Engineering*, 6(3), 95-104.

SALCEDO, P.; MARASENI, T. N.; MCDOUGALL, K. Carbon sequestration potential of spotted gum (*Corymbia citriodora* subspecies variegate) in South East Queenland, Australia. *International Journal of Environmental Studies*, v. 69, n. 5, p. 770-784, 2012.

SEVERO, E. T. D.; SANSIGOLO, C. A.; CALONEGO, F. W.; BARREIROS, R. M. (2013). Kraft pulp from juvenile and mature woods of Corymbia citriodora. *BioResources*, 8(2), 1657-1664.

SEVERO, E. T. D.; CALONEGO, F. W.; SANSIGOLO, C. A. (2006). Composição química da madeira de *Eucalyptus citriodora* em função das direções estruturais. *Silva Lusitana*, 14(1), 113-126.

SILVA, C. J.; VALE, A. T.; MIGUEL, E. P. (2015a). Densidade básica da madeira de espécies arbóreas de Cerradão do estado de Tocantins. *Pesquisa Florestal Brasileira*, 35(82), 63-75.

SILVA, M. R.; BRITO, J. O.; GOVONE, J. S.; MACHADO, G. O.; CALIL JUNIOR, C.; CHRISTOFORO, A. L.; LAHR, F. A. R. (2015b). Chemical and mechanical properties changes in *Corymbia citriodora* wood submitted to heat treatment. *International Journal of Materials Engineering*, 5(4), 98-104.

SILVA, P. H. M.; POGGIANI, F.; FERRAZ, A. V.; SIXEL, R. M. M.; BRITO, J. O. (2012). Balanço nutricional, produção de óleo essencial e madeira de *Corymbia citriodora* Hill & Johnson com aplicação de lodo de esgoto e fertilizante mineral. Ciência Florestal, 22(4), 821-831.

TAVARES, M. A. M. E.; TAVARES, S. R. L. (2015). Perspectivas para a participação do Brasil no mercado internacional de pellets. *Holos*, 5(31), 292-306.

ZANGIÁCOMO, A. L.; CHRISTOFORO, A. L.; GONÇALVES, D.; LAHR, F. A. R. (2014). Evaluation of the Shear effect to determine the Longitudinal Modulus of Elasticity in *Corymbia citriodora* round timber beams. International Journal of Materials Engineering, 4(1), 37-40.

COMO CITAR ESTE ARTIGO:

Nogueira, M. C. J. A., Vasconcelos, J. S., Araujo, V. A. de, Christoforo, A. L., Lahr, F. A. R. (2021). CHARACTERIZATION OF Corymbia citriodora WOOD FOR CONSTRUCTION. *Holos*. 37(1), 1-11.

SOBRE OS AUTORES

M. C. J. A. NOGUEIRA
Possui Doutorado em Engenharia Civil pela USP, Mestrado em Arquitetura e Urbanismo pela USP e Bacharelado em Engenharia Civil pela UFMT. Atua como Professora Titular da UFMT e orientadora de pós-graduação nas áreas de conforto térmico e clima urbano, geometria urbana, ilha de calor, impacto da vegetação, impacto do adensamento nos microclimas urbanos e bioclimatologia.
E-mail: mcjanj@gmail.com
ORCID ID: http://orcid.org/0000-0002-9227-2999

J. S. VASCONCELOS
Possui Mestrado em Engenharia Urbana pela UFSCar e bacharelados em Engenharia Industrial Madeireira pela UNESP e Engenharia da Computação pela UNIVESP. Atua como Pesquisador-bolsista de Doutorado pela UNESP e Cientista pelo grupo de pesquisa LIGNO nas áreas de urbanismo climático, objetos em madeira, sensores e medidores de processos fabris, anatomia da madeira e identificação de madeiras carbonizadas. E-mail: julianojsv@yahoo.com.br
ORCID ID: http://orcid.org/0000-0002-3305-0384

V. A. DE ARAUJO
Possui Pós-Doutorado em Engenharia Civil pela UFSCar, Doutorado-Direto em Ciências dos Recursos Florestais pela USP e Bacharelado em Engenharia Industrial Madeireira pela UNESP. Atua como Cientista Independente nos grupos de pesquisa LIGNO e GeTecSAM e keynote-speaker em conferências científicas para as áreas de habitação em madeira, produtos florestais, indústria da construção, estudos setoriais e soluções sustentáveis.
E-mail: engim.victor@yahoo.de
ORCID ID: http://orcid.org/0000-0002-2747-4738

A. L. CHRISTOFORO
Possui Pós-Doutorados em Engenharia de Estruturas pela USP e em Engenharia de Materiais e Estruturas pela UNESP, Doutorado e Mestrado em Engenharia de Estruturas pela USP e Bacharelado em Engenharia Civil pela UNIFRAN. Atua como Professor Adjunto na UFSCar e orientador de pós-graduação nas áreas de modelagem numérica, estruturas de madeira, materiais compósitos e produção e caracterização da madeira e compósitos.
E-mail: christoforoal@yahoo.com.br
ORCID ID: http://orcid.org/0000-0002-4066-080X

F. A. R. LAHR
Possui Doutorado e Mestrado em Engenharia de Estruturas pela USP e Bacharelado em Engenharia Civil

HOLOS
ISSN 1807 - 1600

pela USP. Tem atuado como Professor Titular na USP e orientador de pós-graduação nas áreas de propriedades e aplicações das madeiras e dos compósitos à base de madeira, estruturas de cobertura, pontes, fôrmas e cimbramentos, normalização, metodologia de ensaio, insumos alternativos na produção de painéis.
E-mail: frocco@sc.usp.br
ORCID ID: http://orcid.org/0000-0002-3510-8498

Editor(a) Responsável: Fábio Paiva

Pareceristas *Ad Hoc*: Tiago Hendrigo de Almeida e Luciano Varanda