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ARTIGO

# Scientific determination and wood anatomical features of species know in Brazilian Amazonia as matá-matá (*Eschweilera* spp.)

## *Determinação científica e características anatômicas da madeira de espécies brasileiras conhecidas por matá-matá (Eschweilera spp.)*

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**ABSTRACT:** Despite the large diversity, logging on Brazilian Amazon is restricted to a small number of species. On relating the local biodiversity to the density, region of occurrence and logging of traditional species, we verified the increment of their shortage. One way to minimize this problem is by introducing new species in the market. Based on these considerations, we sought to identify in the field, woods known as matá-matá (*Eschweilera* Mart. Ex DC. – Lecythidaceae) of high frequency in the Brazilian Amazon. For this, eleven trees were collected for scientific identification, and for anatomical, physical and chemical analyses. During the identification, we verified the presence of six species (*Eschweilera amazonica, Eschweilera coriacea, Eschweilera grandiflora, Eschweilera idatimon, Eschweilera ovata* and *Eschweilera* sp.) which may be identified in the forest by their rytidomes and live bark characteristics. By organoleptic properties, we grouped the woods into three groups with distinct colours, which permitted the identification of two species by their characteristics of taste and smell. Macroscopically, all woods seemed similar, while microscopically, the species presented few differences which made their partial separation possible.

**KEYWORDS**
Tropical forests
Identification
Wood anatomy
Amazon

**RESUMO:** *Apesar da grande diversidade de espécies florestais amazônicas, o corte de árvores é restrito a um pequeno número de espécies. Com relação à densidade da biodiversidade local, à região de ocorrência e ao registro de espécies tradicionais, verificou-se um aumento da escassez dessas espécies. Uma forma de minimizar tal problema é pela introdução de novas espécies no mercado. Considerando-se essa possibilidade, buscou-se identificar no campo espécimes conhecidas por matá-matá (Eschweilera spp. – Lecythidaceae), uma vez que é um gênero muito abundante na Floresta Amazônica. Para isso, amostras de 11 indivíduos foram coletadas para identificação científica e análises anatômicas, físicas e químicas. Esses indivíduos foram classificados em seis espécies: Eschweilera amazonica, Eschweilera coriacea, Eschweilera grandiflora, Eschweilera idatimon, Eschweilera ovata e Eschweilera sp., que podem ser identificadas pelas características de suas cascas. Pelas propriedades organolépticas, tais espécies foram agrupadas em três grupos de coloração distinta, o que permitiu a identificação de duas espécies pelas características de sabor e cheiro. Macroscopicamente, a madeira de todas as espécies parecia semelhante; microscopicamente, as espécies apresentaram poucas diferenças que possibilitaram sua parcial separação.*

**PALAVRAS-CHAVE**
Florestas tropicais
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# 1 Introduction

The unplanned, intense and selective forest extraction performed in the Brazilian Rainforest has transformed forests of high timber stocks and commercial value in degraded forests of low economic potential and difficult recovery, thus contributing to the significant reduction of native species traditionally traded, resulting in losses for both biological and genetic diversity (PINTO et al., 2002). Angelo, Brasil and Santos (2001) mention that, of the 700 known timber tree species, only a few are exploited and exported.

Thus, minimizing the exploitation intensity of traditional species by insertion of new species in the market grows in importance both in trade and in biodiversity conservation. In this context, it is suggested *Eschweilera* Mart. ex DC, commonly known as matá-matá, which, according to Mori and Prance (1990), is considered the largest genus in the family Lecythidaceae.

Even though it is the genus most frequently found throughout the rainforest, about 5,6% of representativeness (STEEGE et al., 2006), their species are not available in the market due to, among others, the lack of knowledge on its properties and low information relative to their identification.

Enterprise data on forest inventories reveal that in addition to high population density, mata-matá trees often shows ideal diameter, cylindrical stem and minimum height to cut, indicating great commercial potential of this genus. Even now, it is not used due to lack of information.

However, studies on technological utilization should be based on correct identification and differentiation of species, so the technological differences inherent of each species are respected, as well as to prevent errors during forest inventory, because when species are misidentified, usually the trees left in the forest to spread seed could not correspond to the trees cropped, as alerted by Procópio and Secco (2008), causing loss of genetic diversity.

The genre *Eschweilera* is very abundant in amazon forest – 5,6% for Steege et al., 2006 and 8,752% for Oliveira et al., 2011; both studies in Pará state. Lima et al., 2002 found out that species of the *Eschweilera* genus regenerated well.

Thus, the work aim to help in determining and identifying of the species of the genus *Eschweilera* Mart. Ex DC, and provide anatomical characters, supporting further studies related to their technological properties and possible commercialization.

# 2 Materials and Methods

The material was collected in primary forest area, explored by a company for wood exploration, with forest certification, located in Paragominas – PA, Brazil. It was obtained permission to explore 11 individuals, according to established standards for forest management, selected randomly by the company's forest inventory, where the trees of mata-mata was identified only by the genus. The 11 individuals were collected and sent to the correct botanical identification. After this identification, was detected the presence of more than one species.

Each felled tree was deployed in central planks with proximally dimensions of 10 cm thick and 200 cm long, with a minimum of 50 cm wide. Since there was formation of large cracks after the logging of the first samples, we began using the ring suppression technique to avoid this. Due to the cracks of the base of some trees, the disks were withdrawn at 8.2 m high. These planks were used for physical, mechanical and energetic characterization of the wood, which will be reported in another paper.

To assist in determination of which species were being collected, it was observed in situ samples still standing, in order to collect information regarding rhytidome, living bark, leaf and botanical characters by using the guidelines issued by Ferreira and Andrade (2006). The botanical sampling for identification followed traditional methods of pressing and preserving. Of all samples, nine individuals were considered vegetative and the others, fertile, aiming elaboration, further identification and registration of herbarium specimens. The identification was made by comparison with pre-determined samples by botanists experts, in the herbarium of the Brazilian Agricultural Research Corporation - Embrapa and the Paraense Emílio Goeldi Museum - MPEG. The vouchers were recorded and incorporated into the herbarium collection of IAN (Agronomic Institute of the North), located at Eastern Amazon Embrapa and MG (Goeldi Museum), located in MPEG.

The anatomic samples were made from wood discs, with approximate dimensions of 5 × 5 × 6 cm in the tangential direction, radial and longitudinal, respectively. For each individual, were removed and examined two equidistant samples, located in the strip between the cambial zone and juvenile xylem.

The observations of the wood's macroscopic and organoleptic characteristics were taken with a 10× magnifying glass and according to rules issued by IBAMA (1992). To capture the images of the transverse and tangential sections of the samples we used a Opton magnifying glass coupled to a Pixelink PL-A662 digital camera.

For the microscopic anatomical characterization, new samples, with dimensions of 1 × 1 cm in the tangential and radial directions and 1,5 cm in the transverse direction, were fabricated and were subjected to cooking in water at 70 °C for a period of 22 hours in order to soften the wood to obtain histological sections. This procedure was necessary because of the high resistance of the wood to cut and, which hindered the process of obtaining the histological sections. However, for some samples, it was also necessary cooking in nitric acid and distilled water, in proportion 1:10 for 10 minutes to allow the cutting of the transverse section.

Microscopy followed the guidelines established by the International Association of Wood Anatomists - IAWA COMMITTEE (1989), where each individual had each of its anatomical characters measured 50 times. After this, the average was calculated for those of the same species.

Although the literature recommends a minimum number of individuals per species for anatomical and morphological characterization than the number used in this work, it was not possible to collect more individuals according to patterns of forest management.

Data analysis was performed using descriptive statistics, obtaining the values of maximum, minimum, average and coefficient of variation for the vessel elements, fibers and parenchyma and analysis of variance. The average test of Scott-

Knott, with a 5% significance level, was used to determine if there were statistical differences between the averages shown.

## 3 Results and Discussion

During the collection of material it was possible to separate the samples collected in six different groups, through the leaf and bark characters (Table 1), using the regional nomenclature to distinguish them, however, could not be said, with certainty, whether they were of different species. As for the botanical identification, a study was conducted with experts from EMBRAPA and MPEG, aiming the correct identification of herbarium specimens collected, which indicated the presence of six distinct species. The grouping, as well as their scientific identifications, is shown in Table 1. Several authors stress the problem of popular grouping occurring in the Amazon (FERREIRA; HOPKINS, 2004; SOUSA; MOUTINHO; SILVA, 2007; MOUTINHO; SOUZA; SILVA, 2008), which many times puts together woods of different genera and/ or species with different technological properties, basically having in common the similarity in color and density.

This practice in the forest inventory ends up providing non reliable data about the richness and equity diversity of forest to be explored, in which, according to Melo (2008), richness refers to the number of species in a community and equity to the form by which the numbers of individuals are distributed among species. This may result in many ecological damages as the scarcity and even the local extinction of some species due to wrong identification of the samples, and even impairing the smoothness in the marketing of timber.

The samples had, in general, dense canopy, medium to large size, cylindrical bodies, average commercial height of 25 m and diameters close to 60 cm; ordinary leaves displayed alternately, pinnate venation and smooth, glabrous surface. Sap-wood and heartwood distincts. Ocurrence of crack after the fall, requiring the ring suppression technique to possibility the usage of the log. The texture, luster and grain shown to be thin, moderate and direct, respectively, for all species. The characteristics of rhytidome, phloem, leaf lamina, among others, are presented in Tables 1, 2.

Among the studied groups, those known as matá-matá CI and black matá-matá were the most difficult to identify botanically. For matá-matá CI, there were no herbarium specimens corresponding to the collected material in the herbarium of the respective institutions, and their identification was limited to botanical genus. Whereas, in Mori (1981) and Wendt, Mori and Prance (1985) *Eschweilera* genus is considered the largest of the neotropical Lecythidaceae, with about 100 species, as well as the most complex and most deficient in sampling, the expected difficulty in identification, as well as the possibility of not having it completely, was an assumption raised by the research team. This result confirms the need for further studies on the species of this genus.

For black matá-matá, there were, among individuals collected, differences in phloem coloration and presence or absence of tabular roots causing uncertainty regarding the presence of different species in one group. While two individuals showed no buttress roots and phloem close to red and indistinct odor, the others showed tabular roots and its bark was whitish and odor similar to sugarcane juice. Meanwhile, all four individuals collected as black matá-matá were considered as belonging to the species *Eschweilera grandiflora*, according to the experts involved.

The characteristic of the tree's phloem has great taxonomic importance, and Procópio and Secco (2008) used this characteristic to separate species of *Cariniana micrantha* from *Couratari stellata*, both belonging to Lecythidaceae. However, Ferreira and Andrade (2006) warn that the color can change due to the time of air exposure in some species. Indeed, the data were collected at the time of the withdrawal of rhytidome and still there were significant visual differences. Thus, detailed studies concerning the botanical identification of these species would be interesting to solve these doubts, as well as to improve the herbarium collection involved.

The wood of the species collected were, in general, different in color and designs can be grouped into three distinct colors: yellow-grey, brown and red with brindle designs. Several scholars, among them Coradin and Camargo (2002), Ferreira, Gomes and Hopkins (2004) and Zenid (2008) cite that the grouping of species by characteristics such as color and density

**Table 1.** General characteristics of rhytidome and phloem of matá-matá ci (*Eschweilera* sp.), red matá-matá (*E. idatimon),* black matá-matá (*E. ograndiflora*), white matá-matá (*E. coriacea*), matá-matá jibóia (*E. ovata*) e matá-matá jatereu (*E. amazonica).* Origin: Paragominas, PA, Brazil.

| Group | Species | Rhytidome | | | Phloem | | Fiber Zone |
|---|---|---|---|---|---|---|---|
| | | Appearence | Attachment | M.C.R. | Colour | Odour/ resemblance | |
| Matá-matá CI | *Eschweilera* sp. | scattered lenticels | depressions | high | light brown | medium, sweet | Present |
| Red Matá-matá | *E. idatimon* | dirty or rough | fibrous plates | low | reddish | indistinct | Present |
| | *E. idatimon* | dirty or rough | fibrous plates | low | reddish | indistinct | Present |
| Black Matá-matá | *E. grandiflora* | dirty or rough | fibrous plates | low | yellowish white | light, sugarcane juice | Present |
| | *E. grandiflora* | dirty or rough | fibrous plates | low | red | light, sugarcane juice | Present |
| | *E. grandiflora* | dirty or rough | fibrous plates | low | yellowish white | light, sugarcane juice | Present |
| | *E. grandiflora* | dirty or rough | fibrous plates | low | reddish | light, sugarcane juice | Present |
| White Matá-matá | *E. coriacea* | dirty or rough | fibrous plates | low | light brown | strong, sugarcane juice | Present |
| | *E. coriacea* | dirty or rough | fibrous plates | low | light brown | strong, sugarcane juice | Present |
| Matá-matá jibóia | *E. ovata* | smooth | scales | low | high red | indistinct | Absent |
| Matá-matá jatereu | *E. amazonica* | scattered lenticels | depressions | high | light brown | strong, faeces | Absent |

*M.C.R. – Machete Cut Resistance.

**Table 2.** Wood organoleptic properties and general characteristics of buttress roots and leaf lamina of matá-matá CI (*Eschweilera* sp.), red matá-matá (*E. idatimon),* black matá-matá (*E. ograndiflora*), white matá-matá (*E. coriacea*), matá-matá jibóia (*E. ovata*) e matá-matá jatereu (*E. amazonica).* Origin: Paragominas, PA, Brazil.

| Group | Species | Buttress root (m) | Limbo | Wood Organoleptic Properties | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Weigh | Colour | Drawing | Taste | Odour |
| Matá-matá CI | *Eschweilera* sp. | 0,20 | elliptical | very heavy | brown-grey | absent | indistinct | indistinct |
| Red Matá-matá | *E. idatimon* | Absent | obovate | very heavy | reddish | brindle | light - bitter | indistinct |
| | *E. idatimon* | absent | obovate | heavy | reddish | brindle | indistinct | indistinct |
| Black Matá-matá | *E. grandiflora* | 0,32 | oblong to elliptic-oblong | very heavy | yellow-grey | discontinuous darks stripes | Bitter | indistinct |
| | *E. grandiflora* | 0,96 | oblong to elliptic-oblong | very heavy | yellow-grey | | bitter | indistinct |
| | *E. grandiflora* | 0,60 | oblong to elliptic-oblong | very heavy | yellow-grey | | strong - bitter | indistinct |
| | *E. grandiflora* | absent | oblong to elliptic-oblong | very heavy | yellow-grey | dark spotts | bitter | indistinct |
| White Matá-matá | *E. coriacea* | 1,51 | linear to elliptical | very heavy | brown-grey | discontinuous darks stripes | strong - bitter | indistinct |
| | *E. coriacea* | 1,40 | linear to elliptical | very heavy | yellow-grey | | bitter | indistinct |
| Matá-matá jibóia | *E. ovata* | absent | elliptical to obovate | very heavy | reddish | brindle | indistinct | indistinct |
| Matá-matá jatereu | *E. amazonica* | absent | elliptical to obovate | very heavy | brown-grey | dark spotts | faeces | unpleasant |

of their wood, can be detrimental to the market due to inexact notion of what is being sold because different species often show different properties of the woods.

And the same time, by combining these with other organoleptic characteristics, like odor and taste, it is possible to separate some of the samples to the level of species, such as *Eschweilera amazonica* and *E. grandifolia*, both brown, but the former has an unpleasant taste and odor similar to manure and the second presents a bitter taste and indistinct odor.

For Camargos and Gonçalez (2001), color can be considered one of the most important characteristics for species identification, especially when associated with aspects of texture and design. However, species of red tone with brindle designs studied here (*E. idatimon* and *E. ovata*), were not identifiable because, despite a slight difference in their colors, the color intensity can be influenced, according Gonçalez et al. (2001) by factors such as the location of sample removal, tree aging, chemical composition etc, as well as the time when the wood was exposed to the environment, because usually the air reacts with the extractives present in the material, causing color changes. As examples, there is the case of mahogany (*Swietenia macrophylla* King.) and Cedar (*Cedrela odorata* L.), similar timber when cut, but, over time, while the cedar's color remains almost invariable, mahogany acquires a darker shade.

Yellowish-grey woods (*E. coriacea* and other individuals of *E. grandiflora*) were very similar, making their identification by general characteristics of the wood unviable.

Is important to say that is difficult to identify a species based on characteristics of a single individual. Thus, the results obtained may be corroborated with further studies, because it still allow a differentiation of the species popularly known as matá-matá.

In general, all the samples analyzed showed, macroscopically, distinct growth rings, individualized by darker transverse tick-walled fibers areas and distance between the rows of parenchyma. Pores seen to the naked eye, diffuse, forming small radial chains, predominantly multiple, often obstructed by tylosis, vascular straight lines in tangential section. Axial parenchyma barely visible to the naked eye in numerous lines, close, winding, forming a uniform reticulum with the ray. Slim and numerous rays, visible only under 10× lens on cross and tangential sections, not laminated, little mirrored contrast in radial section. Axial secretory canals, pith flecks and included phloem absent.

Microscopically (Figure 1), the vessels were shown to be diffuse in radial arrangement, mostly multiple, ovate to circular averaging 3-4 pores $mm^{-2}$ (Table 3), except for *E. amazonica*, which reported an average of eight pores $mm^{-2}$ tylosis commonly present in all three levels of wood, which may be classified as medium to large, vascular elements with a length close to 550 μm (with exception of matá-matá CI, which showed a value close to 460 μm), occasional appendages present, variable in size, occurring in one or both ends, simple perforation plates, alternate intervascular pits, bordered, simple, small diameter of hard measurement, ray-vascular pits with distinct border, similar and smaller when compared with vascular pits. Fiber with thin to thick walls, ranging from short to long (Table 4) nonseptate and minute to simple pits. Reticulate axial parenchyma, with predominance of two cells wide, with 7-8 cells per parenchyma. Rays heterogeneous, formed in large part by procumbent cells, rarely occurring

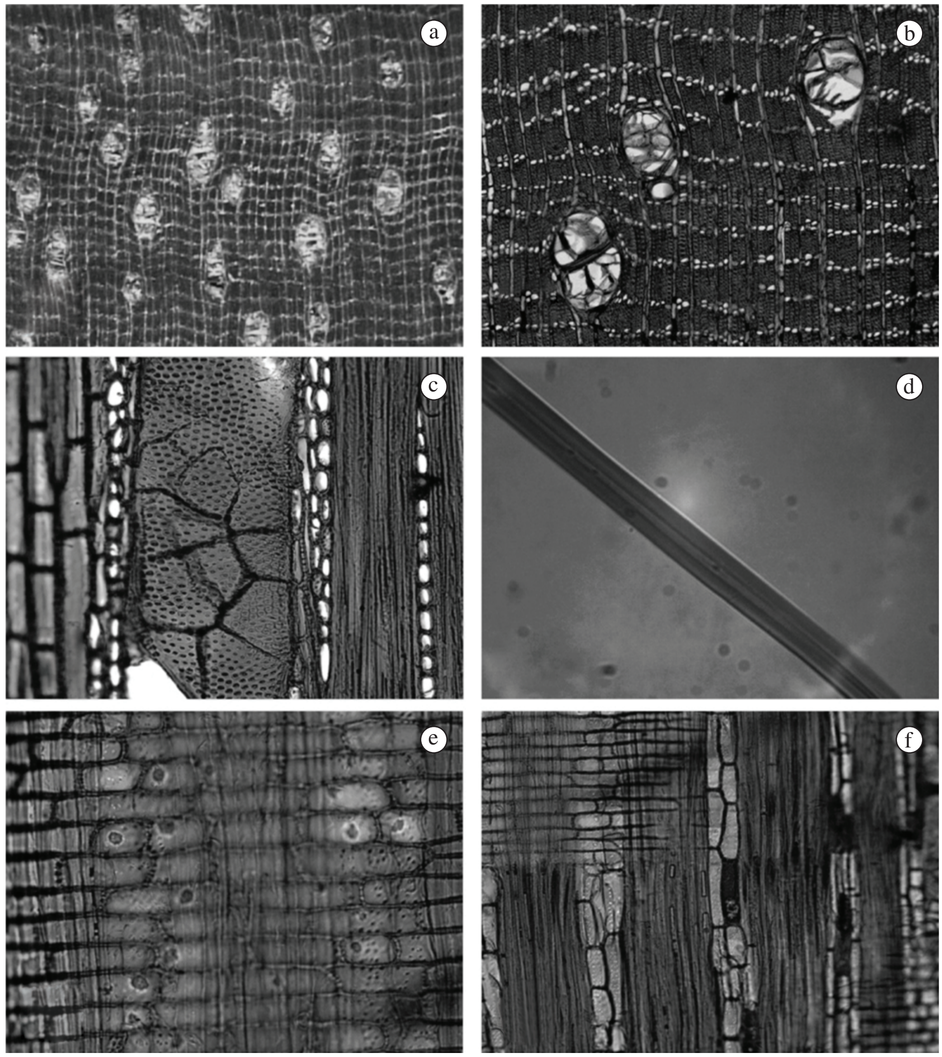


**Figure 1.** General anatomical characters of species of Eschweilera. a- transverse plane photomacrographs of *E. idatimon*. b - transverse plane photomicrograph of *E. ovata*. c - Intervessel pits of *E. grandiflora*. d- *E. ovata* fiber. e- silica grains present in radius cells of *E. coriacea*. f – silica grains present in axial parenchyma of *E. coriacea*. Origin: Paragominas, PA, Brazil.

**Table 3.** Vascular elements biometry of matá-matá CI (*Eschweilera* sp.), red matá-matá (*E. idatimon),* black matá-matá (*E. ograndiflora*), white matá-matá (*E. coriacea*), matá-matá jibóia (*E. ovata*) e matá-matá jatereu (*E. amazonica).* Origin: Paragominas, PA, Brazil.

| Group | Species | Frequency (pores $mm^{-2}$) | | | | Lenght (μm) | | | | Diameter (μm) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Min. | Med. | Max. | C.V. | Min. | Med. | Max. | C.V. | Min. | Med. | Max. | C.V. |
| Matá-matá CI | *Eschweilera* sp. | 2 | 4 C | 6 | 0,25 | 253,30 | 466,57 | 707,10 | 0,24 | 128,10 | 194,93 | 377,80 | 0,27 |
| Red Matá-matá | *E. idatimon* | 2 | 3 B | 6 | 0,26 | 199,50 | 532,81 | 789,10 | 0,22 | 69,30 | 167,28 | 343,00 | 0,34 |
| | *E. idatimon* | 2 | 4 C | 6 | 0,23 | 92,60 | 519,42 | 789,10 | 0,26 | 69,30 | 171,89 | 442,70 | 0,40 |
| Black Matá-matá | *E. grandiflora* | 1 | 4 C | 5 | 0,29 | 270,10 | 555,92 | 703,40 | 0,19 | 101,10 | 232,01 | 390,90 | 0,25 |
| | *E. grandiflora* | 1 | 3 A | 5 | 0,30 | 301,10 | 547,38 | 1031,60 | 0,23 | 107,60 | 229,93 | 491,10 | 0,38 |
| | *E. grandiflora* | 1 | 3 A | 4 | 0,29 | 335,70 | 569,64 | 823,70 | 0,21 | 64,40 | 215,62 | 349,10 | 0,29 |
| | *E. grandiflora* | 2 | 3 B | 5 | 0,27 | 326,20 | 559,92 | 980,20 | 0,24 | 117,50 | 243,10 | 334,00 | 0,22 |
| White Matá-matá | *E. coriacea* | 2 | 3 B | 5 | 0,28 | 192,70 | 530,79 | 788,60 | 0,25 | 107,40 | 219,97 | 343,30 | 0,28 |
| | *E. coriacea* | 3 | 4 C | 5 | 0,20 | 188,90 | 576,11 | 763,70 | 0,21 | 48,90 | 192,14 | 339,90 | 0,33 |
| Matá-matá jibóia | *E. ovata* | 1 | 3 B | 6 | 0,26 | 184,30 | 560,52 | 1286,20 | 0,33 | 81,30 | 188,45 | 385,90 | 0,43 |
| Matá-matá jatereu | *E. amazonica* | 3 | 8 D | 13 | 0,29 | 147,20 | 413,90 | 850,30 | 0,37 | 44,20 | 100,03 | 210,20 | 0,33 |

Where: Min – minimum value; Med – medium value; Max – maximum value; C.V.- Coefficient of variation. *Average values followed by the same letters don't differ among themselves, according to Scott-Knott test ($p < 0,05$).

square cells, uniseriate in prevalence, often fused, and can be classified as quite tall and very thin, often close to 14 rays per mm linear (Tables 5 and 6). Silica grains present in procumbent ray cells, also found in axial parenchyma of the species *E. coriacea.* Chains of oxalate crystals occasionally found in the *E. coriacea*. Overall, the results coincided with those obtained by Détienne and Jacquet (1983).

Despite the homogeneity found among the samples studied, some peculiar characteristics could help identify them, like the silica grains present exclusively in the axial parenchyma cells of *E. coriacea*, differentiating it from black matá-matá, both extremely similar macroscopically, taxonomically and organoleptic wise. It is noteworthy that the presence of silica crystals in species of the genus *Eschweilera* had been alerted by Loureiro, Silva and Alencar (1979) and Vasconcellos, Freitas and Silva (1995). To Zindler-Frank (1987), the crystals found in the secondary xylem tissue are also important tools for taxonomic research, since only one species presented it.

The vascular elements had simple perforation plates, alternate and bordered intervascular pits, indicating a high degree of specialization of these (PINHEIRO, 1999), agreeing with results found by Paula (2006), studying *Eschweilera matamata*.

The amount of pores found in an area of one square millimeter of timber is usually taken by a feature not very practical to support the distinction between species of same genus. Meanwhile, when this feature was very discrepant, one can assume that is linked more to the species than to the environment, so that Silva (2004) used it as a separation subsidy in five species of Curupixá (*Micropholis* - Sapotaceae). Thus, as *E. amazonica* showed almost double the average of other species, been statistic differently, as well as a much smaller diameter when compared to the others studied, it was possible to segregate it with this feature.

The radial parenchyma formation by procumbent and square cells differed from the result published by Paula (2006) for *Eschweilera matamata*, that found only procumbent cells in their formation, which already helps to distinguish this species and those studied here. The types of cells that form the radius are much more linked to the genotype than to the

**Table 4.** Fiber biometry of matá-matá CI (*Eschweilera* sp.), red matá-matá (*E. idatimon),* black matá-matá (*E. grandiflora*), white matá-matá (*E. coriacea*), matá-matá jibóia (*E. ovata*) e matá-matá jatereu (*E. amazonica).* Origin: Paragominas, PA, Brazil.

| Group | Species | Lenght (mm) | | | | Lumen diameter (μm) | | | | Wall thickness (μm) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Min. | Med. | Max. | C.V. | Min. | Med. | Max. | C.V. | Min. | Med. | Max. | C.V. |
| Matá-matá CI | *Eschweilera* sp. | 1,32 | 1,50 | 1,86 | 0,12 | 1,04 | 2,20 | 3,81 | 0,28 | 4,51 | 5,83 | 8,20 | 0,12 |
| Red Matá-matá | *E. idatimon* | 1,39 | 1,63 | 1,90 | 0,15 | 1,27 | 2,74 | 5,47 | 0,40 | 4,61 | 6,09 | 8,51 | 0,14 |
| | *E. idatimon* | 1,31 | 1,52 | 1,84 | 0,11 | 3,12 | 5,47 | 8,16 | 0,23 | 4,26 | 5,48 | 7,52 | 0,11 |
| Black Matá-matá | *E. grandiflora* | 1,46 | 1,76 | 2,30 | 0,12 | 1,13 | 2,55 | 4,36 | 0,34 | 4,46 | 6,63 | 9,13 | 0,16 |
| | *E. grandiflora* | 1,43 | 1,64 | 1,78 | 0,05 | 1,40 | 4,16 | 8,60 | 0,42 | 5,10 | 8,14 | 11,05 | 0,18 |
| | *E. grandiflora* | 1,50 | 1,76 | 2,23 | 0,12 | 1,44 | 2,85 | 6,17 | 0,31 | 5,07 | 7,07 | 9,47 | 0,16 |
| | *E. grandiflora* | 1,54 | 1,78 | 2,13 | 0,12 | 1,68 | 2,90 | 5,22 | 0,27 | 4,53 | 7,23 | 10,08 | 0,18 |
| White Matá-matá | *E. coriacea* | 1,62 | 1,94 | 2,52 | 0,11 | 2,03 | 3,93 | 7,30 | 0,30 | 5,30 | 7,52 | 10,33 | 0,14 |
| | *E. coriacea* | 1,62 | 1,82 | 2,21 | 0,13 | 1,44 | 3,46 | 5,94 | 0,28 | 4,89 | 8,07 | 11,48 | 0,17 |
| Matá-matá jibóia | *E. ovata* | 1,26 | 1,53 | 1,79 | 0,13 | 1,83 | 4,12 | 7,97 | 0,41 | 4,34 | 7,98 | 12,16 | 0,17 |
| Matá-matá jatereu | *E. amazonica* | 1,37 | 1,47 | 1,66 | 0,19 | 1,50 | 3,53 C | 6,30 | 0,34 | 4,65 | 6,60 | 9,10 | 0,17 |

Where: Min – minimum value; Med – medium value; Max – maximum value; C.V.- Coefficient of variation.

**Table 5.** Radial parenchyma cells biometry of matá-matá CI (*Eschweilera* sp.), red matá-matá (*E. idatimon),* black matá-matá (*E. grandiflora*), white matá-matá (*E. coriacea*), matá-matá jibóia (*E. ovata*) e matá-matá jatereu (*E. amazonica).* Origin: Paragominas, PA, Brazil.

| Group | Species | Frequency | | | | Height (μm) | | | | Thickness (μm) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Min. | Med. | Max. | C.V. | Min. | Med. | Max. | C.V. | Min. | Med. | Max. | C.V. |
| Matá-matá CI | *Eschweilera* sp. | 10 | 12,8 | 16 | 0,11 | 179 | 358 | 533 | 0,29 | 11,96 | 21,73 | 35,93 | 0,30 |
| Red Matá-matá | *E. idatimon* | 7 | 15,5 | 20 | 0,16 | 191 | 317 | 449 | 0,20 | 11,96 | 24,22 | 41,89 | 0,31 |
| | *E. idatimon* | 7 | 10,6 | 15 | 0,13 | 166 | 315 | 486 | 0,25 | 6,09 | 18,09 | 32,68 | 0,31 |
| Black Matá-matá | *E. grandiflora* | 9 | 13,3 | 17 | 0,15 | 224 | 363 | 560 | 0,17 | 8,50 | 22,40 | 39,70 | 0,28 |
| | *E. grandiflora* | 10 | 13,5 | 16 | 0,09 | 210 | 374 | 587 | 0,21 | 10,60 | 19,00 | 31,90 | 0,29 |
| | *E. grandiflora* | 9 | 14,1 | 19 | 0,17 | 277 | 428 | 542 | 0,14 | 13,20 | 26,36 | 39,70 | 0,25 |
| | *E. grandiflora* | 11 | 14,5 | 18 | 0,12 | 175 | 313 | 458 | 0,25 | 9,57 | 17,81 | 30,02 | 0,29 |
| White Matá-matá | *E. coriacea* | 9 | 13,7 | 17 | 0,13 | 114 | 173 A | 233 | 0,20 | 4,87 | 9,41 | 16,84 | 0,30 |
| | *E. coriacea* | 12 | 15,1 | 19 | 0,11 | 247 | 404 | 611 | 0,17 | 13,30 | 23,90 | 42,40 | 0,28 |
| Matá-matá jibóia | *E. ovata* | 10 | 14,4 | 17 | 0,12 | 252 | 384 | 516 | 0,20 | 10,80 | 20,85 | 37,30 | 0,30 |
| Matá-matá jatereu | *E. amazonica* | 9 | 12,6 B | 16 | 0,12 | 244 | 340 C | 501 | 0,17 | 10,70 | 20,98 | 34,70 | 0,24 |

**Table 6.** Radial parenchyma cells and vascular element appendices biometry of matá-matá CI (*Eschweilera* sp.), red matá-matá (*E. idatimon),* black matá-matá (*E. grandiflora*), white matá-matá (*E. coriacea*), matá-matá jibóia (*E. ovata*) e matá-matá jatereu (*E. amazonica).* Origin: Paragominas, PA, Brazil.

| Group | Species | Height (number of cells) | | | | Thickness (number of cells) | | | | Appendix (μm) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Min. | Med. | Max. | C.V. | Min. | Med. | Max. | C.V. | Min. | Med. | Max. | C.V. |
| Matá-matá ci | *Eschweilera* sp. | 7 | 16 | 24 | 0,29 | 1 | 1,18 | 2 | 0,33 | 34,60 | 111,75 | 291,00 | 0,57 |
| Red Matá-matá | *E. idatimon* | 8 | 14 | 21 | 0,22 | 1 | 1,28 | 2 | 0,36 | 69,30 | 167,28 | 343,00 | 0,34 |
| | *E. idatimon* | 6 | 12 | 17 | 0,22 | 1 | 1,36 | 2 | 0,35 | 46,40 | 109,27 | 243,00 | 0,46 |
| Black Matá-matá | *E. grandiflora* | 9 | 18 | 25 | 0,17 | 1 | 1,34 | 2 | 0,36 | 38,00 | 122,63 | 188,85 | 0,55 |
| | *E. grandiflora* | 10 | 17 | 16 | 0,09 | 1 | 1,32 | 2 | 0,34 | 43,70 | 111,35 | 242,40 | 0,38 |
| | *E. grandiflora* | 13 | 17 | 22 | 0,14 | 1 | 1,36 | 2 | 0,31 | 61,30 | 98,32 | 125,70 | 0,27 |
| | *E. grandiflora* | 9 | 15 | 23 | 0,26 | 1 | 1,10 | 2 | 0,28 | 34,80 | 104,98 | 212,10 | 0,55 |
| White Matá-matá | *E. coriacea* | 9 | 16 | 22 | 0,19 | 1 | 1,06 | 2 | 0,23 | 78,30 | 180,13 | 471,00 | 0,60 |
| | *E. coriacea* | 10 | 16 | 21 | 0,17 | 1 | 1,72 | 3 | 0,29 | 48,00 | 118,74 | 358,50 | 0,60 |
| Matá-matá jibóia | *E. ovata* | 9 | 14 | 20 | 0,18 | 1 | 1,14 | 2 | 0,31 | 87,90 | 111,33 | 152,10 | 0,32 |
| Matá-matá jatereu | *E. amazonica* | 11 | 17 C | 24 | 0,18 | 1 | 1,80 | 2 | 0,22 | 27,70 | 70,09 | 159,20 | 0,47 |

ecological anatomy, however, it is noteworthy that the cited author worked with a species that is not present in this study, what may elucidate the difference found.

Marcati, Oliveira and Machado (2006), Bass and Vetter (1989); Ekstein et al. (1995) and Coradin (2000), showed that the existing growth rings in wood are of great interest to climatology, hydrology, ecology and dendrochronology, among others. The species of Eschweilera studied showed distinction between the growth rings, which are differentiated by darker thick-walled fibers areas and distance between the rows of axial parenchyma. This result is consistent with those of Loureiro, Silva and Alencar (1979) and Paula (2006), with other species of *Eschweilera*. Brienen and Zuidema (2005), studying *Bertholletia excelsa*, also belonging to the family Lecythidaceae, found great potential for dendrochronological studies in the Amazon rain forest for it. Considering that the genus *Eschweilera* showed homogeneity in its rings formation and distinction, such as *B. excelsa*, studies would be suitable for estimating both dendrochronological potential, as well as its cutting cycle for the correct implementation of forest management.

## 4 Conclusions

Among the collected samples, six distinct species were found, which can be identified in the field by the association of leaf characters, rhytidome and phloem.

The matá-matá wood can be grouped by organoleptic properties in three different groups, allowing the identification of *Eschweilera* sp., *E. amazonica* and *E. grandiflora*. On macroscopic examination, the species proved to be too similar, except for *E. amazonica*, which presented an average frequency of pores well above the rest. Microscopy allowed us to separate the species *E. coriacea* from the others due to presence of silica in the axial parenchyma.

It is recommended, for future studies, to increase the sampling of the species analyzed, in order to corroborate the identification of the species in question, and to minimize the variation of the data.

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