

MOST COMMON TIMBERS IN BRAZILIAN WOOD HISTORICAL ARTEFACTS

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Abstract:

The present work lists the most common timbers used in wooden historical artefacts from Brazil. The data-base used was the records of the wood identification from 97 artefacts, such as religious icons, historical furniture, ornaments and carvings, in the past twelve years at the Wood and Wood Products Laboratory. From these woods the properties related to artefacts manufacturing such as wood hardness, dimensional stability and work ability were gathered. Based on these properties a list of possible alternative of woods, considering the availability in the market and environmental constraints was obtained. We hope that these results will help in the restoration process of historical artefacts.

Key words: wood species; botanical identification; historical heritage.

INTRODUCTION

Wooden historical artefacts can provide significant information about the technological aspects of woodcrafts. Questions like what timbers were chosen and what properties were taken into account in selecting them can be answered by identifying the wood from which these artefacts were made.

Also, for restoration purposes it is necessary to know the timber used in the manufacturing of the historical artefacts since it is desirable to use the same timber in the process (Wheeler and Baas 1998). However some wood species used in manufacturing some old artefacts may be classified as in danger or are facing commercial restrained laws. As a result, there is a need for alternative woods for the restoration which have properties as similar to the original wood as possible. The replacement must be done with care due to the large variation between the timbers' properties.

The Wood and Wood Products Laboratory from the Institute of Technological Research (IPT) is constantly inquired for wood identification of historical artefacts, most of them from the 17th and 18th centuries. Information about Brazilian timbers used during the colonial period is scarce. In a historical document written by the Portuguese (Sales 1723) was found entries about some timbers. It describes some features and some application for jacaranda and American cedar. Then it is expected that there is a combination of timbers selected by the craftsmen from the colonial period of Brazil. Having this purpose in mind, it was analyzed the wood identification done in the last 12 years in our Lab and listed the most common timbers used.

Based on this list a search in the literature was done in order to find the values for the desirable wood properties for artefact and furniture manufacturing.

It is important to emphasize that the Standards, Codes of Ethics and Professional Conduct aimed at conservation and restoration workers published in several countries, mention that the restoration of wooden historical artefacts has to be done, preferably, with the same wood species but, if not possible, it may use materials that are, at least, compatible by their similarities of physical and mechanical characteristics (Brandi 2004, Queimado and Gomes, Giovanella 2009).

The Italian standard UNI 11161 (2205) emphasizes the need for botanical identification of wood as an essential requirement in conservation work, maintenance and restoration of wooden pieces of historical and cultural heritage.

If relevant and necessary, aiming to help in the restoration process decision, we also suggested some timbers more available in the Brazilian market and without legal restraints.

OBJECTIVE

The aim of this work is to enlist the most common timbers used for the manufacturing of wooden historical artefacts. It is also indicated possible alternatives of timbers to be used in restoration, considering their properties and availability, to assist in decision making in the restoration procedure.

MATERIAL AND METHODS

Material

In the past twelve years the Wood and Wood Products Laboratory has identified the wood of 97 historical artefacts from the 17th and 18th centuries. These artefacts were religious icons, picture-frames, colonial furniture and painted panels.

The samples were sent by restorers joined or not to various institutes / organizations in the field of conservation and restoration.

Fragment extraction is a crucial and sensitive step for the wood identification. Although it is desirable to make the minimum damage to the object, it is also required enough sample size and quality for the wood anatomy observation. Some methods analyze the wood anatomy in situ (Ruffinatto *et al.* 2010), but most of the times it is fast and necessary to extract samples from the historical objects (Hoadley 1990; Heady *et al.* 2010). For this reason, most of the fragments that were identified had size varying from 1mm to 5mm (Fig. 1).

Because of the small size of the wood fragments, microscopic analysis of the wood anatomy features is required. Although the fragments sizes have demanded extreme care and skillful hands, the procedures for the preparation and sectioning of the samples are the same used for standard wood blocks (cubic samples of 5 to 15mm).



Fig. 1

Wood fragments (left) from a historical artefact and the histological slides (right). Scale bar = 10mm.

Wood identification

During the wood identification process it was gathered as much information about the sample as possible. For wooden historical artefacts it was inquired about the provenance and the claimed common name, but sometimes these information were not available or wasn't reliable.

When possible, the artefact or fragment was also examined macroscopically and taken notes about color, luster, figure, odor and hardness. Sometimes anatomical features like axial parenchyma could be seen. Care was taken in this analysis, since finish, stain and age can mantle these features (Hoadley 1990).

For the microscopic observation it was use the lists of features from the International Association of Wood Anatomy (IAWA Committee 1989, 2004). After enlisting the observed features it was searched in wood anatomy databases (Wheeler 2004) and in the literature (Détienne and Jacquet 1983, Hoadley 1990) for possible matches to the unknown wood. Finally it was compared the histological slices from the unknown wood to the slices from the Calvino Mainieri Wood Collection (BCTw). The Collection has around 18 thousand wood samples and 15 thousand slices.

Useful wood properties for artefacts and furniture crafting

Nowadays some important wood properties for artefact and furniture crafting are measured. For sculptures, panels and furniture decoration carving, suitable woods is recommended to have medium or low hardness (from 1000N to 9000N); medium to very low shrinkage (radial <4.5%, tangential <9.0% and volumetric <13.5%). It is also desirable features for the wood good finishing and easy work ability (SUDAM/IPT 1981).

RESULTS

Wood Identification

The analysis of the 97 wood artefacts identified in the Wood and Wood Products Laboratory in the past twelve years, resulted in a group of fifteen timbers listed below:

- American cedar (*Cedrela fissilis* and *C. odorata*, Meliaceae);
- Vinhatico (*Plathymenia reticulata*, Leguminosae)
- Laurel (*Nectandra* spp. and *Ocotea* spp., Lauraceae);
- Parana pine (*Araucaria angustifolia*, Araucariaceae)
- Jequitiba (*Cariniana estrellensis* and *C. legalis*, Lecythidaceae)
- Canjerana (*Cabralea canjerana*, Leguminosae)
- Carvoeiro (*Miconia* sp., Melastomataceae)
- Rosewood (*Dalbergia* spp., Leguminosae)
- American cordia (*Cordia* spp., Boraginaceae)
- Caviuna (*Machaerium scleroxylon*, Leguminosae)
- Balsamo (*Myroxylon balsamum*, Leguminosae)
- Brauna (*Melanoxylon brauna*, Leguminosae)
- American guarea (*Guarea* sp., Meliaceae)
- Cambara (*Gochnatia* sp., Compositae)
- Guapere (*Lamaninia* sp., Cunnoniaceae)

The American cedar was the most common identified timber, encountered in 67% of the artefacts. Among Brazilian species, it is relatively easy to be identified just by observing in a cross section their semi-ring-porous, the marginal axial parenchyma and in the tangential section rays with 2 to 3 cells width (Fig. 1a and Fig. 1b).

At a lower rate other timbers that that are also commonly used by today's woodcraftsmen were identified such as vinhatico, canela and jequitiba (Fig. 1). It was also encountered one of the most important native conifer from Brazil, Parana pine, which can be identified by the absence of resin canals and alternate boarded pits (Fig. 2). Table 1 lists the proportions of artefacts identified for each of these timbers and also the anatomical features, the values and categories from properties desirable in woodcraft.

The other 10 woods were identified in two or less artefacts building up to 16% from the total.

Woods identified in artefacts and their characteristics and properties.

		Common name				
		American cedar	Vinhatico	Laurel*	Jequitiba**	Parana pine
Frequency (%)		67	6	5	3	3
Most frequent uses		polychromy	retable	polychromy	polychromy	polychromy
General characteristics						
Type		hardwood				softwood
Heartwood colour		light redish brown	yellowish brown	yellowish brown	yellowish brown	brownish yellow
Texture		medium	medium	medium	medium	medium
Odour		distinct	indistinct	distint or not	indistinct	indistinct
Anatomical features						
Parenchyma		marginal band	indistinct	indistinct	reticulate	absent
Rays		width 2 to 3 cells	irregular storied width 1 to 2 cells	width 2 to 3 cells	width 1 to 3 cells	uniseriate
Vessels arrangement		semi-ring porous	diffuse	diffuse	diffuse	absent
Growth rings		distinct	indistinct	indistinct	indistinct	distint
Frequency (%)						
Janka Hardness (N) ***		3138	2706	4285	3844	2687
Shrinkage (%)	Radial	4,0	2,1	3,9	3,0	4,0
	Tangencial	6,2	4,7	8,1	5,7	7,8
	Volumetric	11,2	7,7	13,6	9,8	13,2
Finish as coating		good	excellent	good	good	good
Workability		easy	easy	easy	easy	easy

Source: IPT (2013).

* Information of *Ocotea cymbarum*, Lauraceae

** Information of *Cariniana legalis*, Lecythydaceae

*** Results according to ABNT (Brazilian Association of Technical Standards) NBR 7190:1997 "Design of timber structures", Annex B.

Note: There was no occurrence of more than one timber on the received samples.

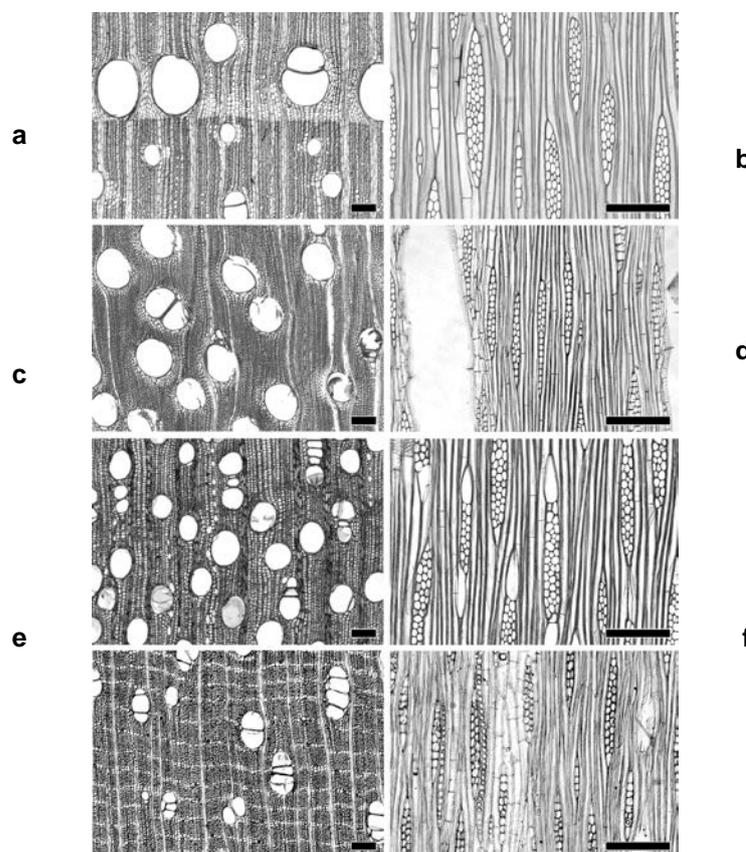


Fig. 1

Wood anatomical features from most common timbers identified in artefacts - hardwoods
a and b – American cedar; c and d – Vinhatico; e and f – Laurel; g and h – Jequitiba. Left pictures –
Cross section; Right pictures – Tangencial section. Scale bar – 200µm.

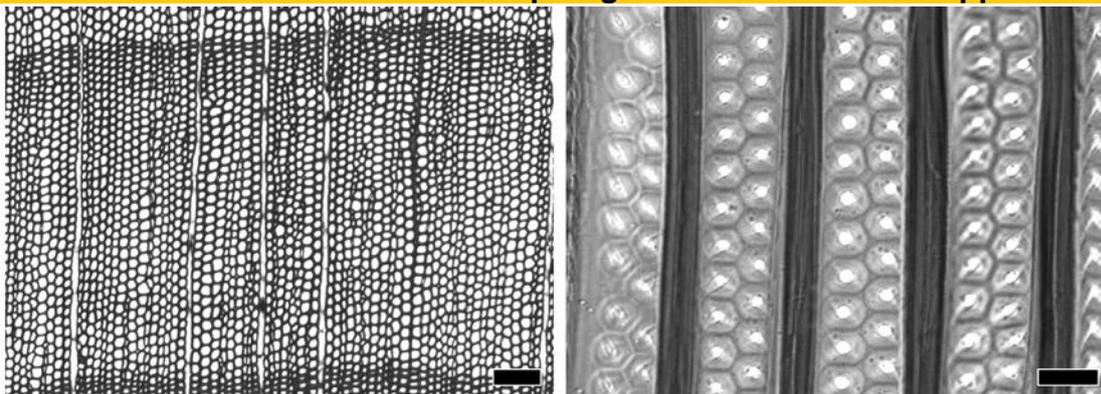


Fig. 2

Wood anatomical features from Parana pine identified in artefacts.

Left picture – Cross section. Scale bar – 200µm; Right picture – Radial section showing the alternate bordered pits. Scale bar – 50µm.

Wood substitute for the traditionally used

The group of woods created considering the end use intended for decoration and adornment, having the technical requirements specified is presented in Tables 2 and 3. When drawing up the group, some species of wood were excluded, for environmental and marketing reasons and others because have more profitable alternative uses, such as, the chestnut (*Bertholletia excelsa*) and copaiba (*Copaifera* spp.).

Table 2

Recommended woods for decoration and adornment and their properties.

	Commom name			
	balata blanc 1	freijo 2	trebol 3	gonçalo alves 4
Type	hardwood			
Heartwood colour	pale red	pale brown	reddish brown	yellowish red with dark streats
Texture	fine	medium	medium	medium
Odour	indistinct	indistinct	indistinct	indistinct
Anatomical features				
Parenchyma	narrow bands	scanty paratraqueal	aliform lozenge-aliform	indistinct
Rays	multiseriate portion(s) as wide as uniseriate portions	large 4 to 10 cells	uniseriate storied	width 1 to 3 cells
Vessels arrangement	radial pattern	cluster	diffuse	diffuse
Growth rings	indistinct	indistinct	distinct	indistinct
Properties				
Janka Hardness (N) *	6325	3932	11817	7737
Shrinkage (%)	Radial	4,7	3,2	4,4
	Tangencial	9,7	6,7	6,7
	Volumetric	14,0	9,1	12,3
Finish as coating	excellent	good	good	excellent
Workability	easy	easy	easy	Easy

1 *Micropholis venulosa*, Sapotaceae; 2 *Cordia goeldiana*, Boraginaceae; 3 *Platymiscium ulei*, Leguminosae; 4 *Astronium lecointei*, Anacardiaceae.

* Results according to ABNT (Brazilian Association of Technical Standards) NBR 7190:1997 Design of timber structures”, Annex B.

Source: IPT (2013).

Table 3

Recommended woods for decoration and adornment and their properties.

	Commom name				
	satiné 1	purple heart 2	tauari 3	timbo rana 4	
Type	hardwood				
Heartwood colour	red	purple	pale yellow	pale brown	
Texture	fine	fine	medium	medium	
Odour	indistinct	indistinct	indistinct	indistinct	
Anatomical features					
Parenchyma	winged aliform	unilateral aliform confluent	reticulate	scanty paratraqueal	
Rays	width 2 to 4 cells	large 4 to 10 cells	width 2 to 5 cells	uniseriate	
Vessels arrangement	diffuse	diffuse	diffuse	diffuse	
Growth rings	indistinct	distinct	indistinct	indistinct	
Properties					
Janka Hardness (N) *	7639	9738	3727	7247	
Shrinkage (%)	Radial	5,3	3,5	4,2	5,1
	Tangencial	7,8	6,5	6,6	8,3
	Volumetric	13,2	10,7	10,9	13,1
Finish as coating	good	good	good	good	
Workability	easy	easy	easy	easy	

1 *Brosimum paraense*, Moraceae; 2 *Peltogyne* spp., Leguminosae; 3 *Couratari* spp., Lecythidaceae (information of *Couratari guianensis*, Lecythidaceae); 4

Pseudopiptadenia psylostachia, Leguminosae.

* Results according to ABNT (Brazilian Association of Technical Standards) NBR 7190:1997 Design of timber structures”, Annex B.

Source: IPT (2013).

Table 4 presents for the five most common wood species identified possible replacements woods considering their characteristics.

Table 4

Indication wood substitute those most common species identified in art objects.

Woods identified	Woods indicated
American cedar	Balata blanc, trebol, satine
Vinhatico	Gonçalo alves, timborana, freijo
Laurel	Freijo, timborana
Jequitibá	Tauari, freijó
Parana pine	Tauari

CONCLUSIONS

The most frequently identified wood was the American cedar (*Cedrela*), which has excellent features for working and carving, hence the preference for its use.

While there are restrictions on trade and unavailability of some woods, American cedar wood is still likely to be found in the market.

Aiming to expand the possibilities of replacing woods identified the search result points to other species with similar characteristics and easily found in the market.

Besides being in accordance with theoretical concepts, Standards in Conservation / Restoration and Codes of Ethics, which should never be ignored; listing several criteria, to be followed by professionals who work in those areas, which includes the guarantee that the highest possible level of original materials is being used or even the possibility of using materials that are compatible by their similarity of physical and mechanical characteristics, it is our hope that the results of this work also contribute as a guide to the decision process to find the best procedure to be used in restoring historical / cultural artefact, as it offers several possibilities for substitution of damaged parts.

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