'CONSAGRADA IMAGEN DE JESUS NAZARENO' OF SONSONATE A XYLOLOGICAL STUDY OF THE WOODEN SCULPTURE SUPPORT

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(Received 29 November 2016, revised 6 December 2016)

Abstract

The study of the wooden statue, representing the 'Imagen Consagrada de Jesus Nazareno' from Sonsonate (El Salvador), marks the importance of the xylologic analysis, at a macroscopically as well as microscopically level, in determining the botanical species used for the realization of works of art. The statue under examination is made of wood and it was created for a religious purpose; therefore it is a religious object of historical ethno-anthropological interest (the sculpture dates back between the 17th and 18th centuries). Some documental sources place the statue in a European area, specifically Italy. The identification of the botanical species allows for some conjectures on the actual origin. The samples were taken from eleven elements of the artwork and, in a first approach, they were studied macroscopically. The samples were taken in such a way that neither the aspect nor the structure was affected in any way. The purpose of this study is to conduct further examination by observing details and enhancing the xylologic analysis microscopically from what remained of the original samples. This was done so as to confirm the geographical area of the species used for the work due to the fact that the origin of the sculpture is still today being debated.

Keywords: wood anatomy, origin, Cedrela odorata L., El Salvador

1. Introduction

In the course of history, wood has been the material per excellence in everyday use for the realization of objects and tools, such as containers, bowls, fabric looms and toys [1]. This has even been taken to use in the most refined constructions and artworks [2]. The evidence that wood can give about the past

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is vast and for this reason, much attention has been directed towards wooden artwork.

This attention has been created a multidisciplinary and interdisciplinary scientific approach towards the study of works, founded on diagnostic research [3, 4].

Knowledge obtained on the botanical species of the wood, used to create an artwork, gives the ability to trace the physical and mechanical characteristics of the wood as well as its durability, given that it is of organic origin and therefore biodegradable. The degradation of the wood occurs in different times and ways; it depends on the botanical species, on the environment and on the conservation modalities. The natural durability of the wood is fundamental for works. In fact, the durability is the innate resistance to the attack of biological xylophagous organisms (moulds, insects, bacteria, marine organisms). The natural durability of a wood species is always referred to in terms of a certain xylophagous organism; however it is not independent of the environment of exercise or conservation [5]. The alterations, of biotic origin, are the cause of evident damage to the woodworks and they compromise the structure. In case of painted wooden artworks, the action of the xylophagous organisms can provoke the loss of sharpness and/or the support of the pictorial layers. This can happen in wooden surfaces of paintings and in statues, due to the tunnels created by larvae [6]. The main structures, due to aggression caused by moulds, lose the capacity of a mechanical resistance and thus reduce resistance in proportion to the reduction of the section. In fact, the biotic alterations compromise the chemical, physical and morphological characteristics and thus reduce wood density [7]. The abiotic factors that influence durability make the wood more or less attackable by xylophagous organisms and modify the behaviour of surfaces exposed to humidity, temperatures and light. The variations of these factors can induce phenomena that activate the physical, mechanical or chemical degradation of works, such as cracks as a result of repeated contraction/expansion, deformations or photochemical alterations on the surface.

The factors that influence the conservation of works include the choice of species, the modalities of workmanship, and issues concerning conservation which are certainly influenced by the temperature and the moisture of the environment [8]. The technological characteristics of the species chosen also determine the approach taken in restoration operations [9, 10], which can for example imply reintegration operations with wood from the same species or the verification of the compatibility of glues or the permeability to conserving substances that are substantially different according to the species. The knowledge of materials that make up the work and particularly the wood, contributes towards a better comprehension of the meaning of the work and the context of production, giving indications for dating, origin, or authentication [11]. The study of anatomical elements and the relationship among these allows for identification of the botanical species from which a certain selection was obtained [12]. It is sufficient to observe the characteristics of a material with the bare eye or a magnifying glass for the macroscopic identification [13].

The colour or differences in colours are observable, the large dimension anatomical structures (for example big rays, resin canals, very big pores as in deciduous oaks or chestnut), special anatomical forms ('Hazel' growth) or characteristic defects (dark colour wood-knots in pine). The attribution to a botanical species is not always easy and, above all, it is not without doubt. For this reason is conducted the microscopic identification which takes into consideration anatomical particularities observable only by microscope, optical or scanning electron microscope (SEM). High level magnification allows the observation of distinctive anatomical characteristics of a species and with the use of dichotomous keys leads towards a plausible diagnosis. However, it is not always possible to reach identification with certainty. In some cases, it is possible to identify the genus but not the species [14]. The case of poplars is exemplary: the anatomical analyses allow for the identification of the *Populus* genus, but do not allow the identification of different species or hybrids.

Figure 1. The head finely carved of the statue of *Jesus Nazareno*.

Figure 2. The terminal parts of the arms and legs carved and painted.

The study of Xylology has a wide application in the field of cultural heritage. The case examined here is a typical example. The detailed analysis is applied towards identifying the botanical species and the origin of the wood for the realization of the processional statue of *Jesus Nazareno* of Sonsonate (El Salvador). This statue is transported through the streets of the city by the faithful during the Holy Week. The statue, which dates back between the 17^{th} and 18^{th} century, is assembled in numerous wooden parts. Only those that are visible are finely carved, such as the head (Figure 1) and the terminal parts of the arms and legs (Figure 2), because the statue is dressed in cloth [15].

Historical sources tell us that the sculpture came to the country thanks to Friar Ramirez de Arellano who was the bishop of the church of La Merced at that time. This person, it seems, commissioned the work to be done by an unknown Florentine artist between 1600 and 1700. For some unknown reasons, the statue was sent to Perù and arrived in Tacuzcalco in 1753. For religious reasons it was moved to Sonsonate some years later. The popular story sets the realization of the statue in a European context, specifically Italy.

Whether the statue was sculpted in Italy or not is still a topic of discussion [16]. A bibliographical research was conducted to determine the history and better understand the ethno-anthropological meaning of the work. The xylologic analysis of the wood was conducted to identify the botanical species used in creating the artwork.

The objective of the study was therefore to analyse microscopically each element of the artwork so as to determine the taxon, by gathering anatomical evidence with scientific methods. The identification of the species allows for the formulation of a hypothesis on the origin thus enhancing the on-going discussion of the origin of the work.

2. Experimental

The samples were taken from different parts of the artwork. The sampling points were photographed and recorded. The samples were taken in such a way as to not damage the sculpture aesthetically or structurally, according to the recommendations provided in the standard UNI 11118 [UNI 11118:2004, *Cultural heritage – wooden artefacts – criteria for the identification of the wood species*]. The wood samples were investigated both macroscopically under visible light and microscopically under a stereo-microscope. Transverse, radial and tangential sections, thick 20-25 μm, were cut from the small samples with the aid of a sliding microtome (Reichert Jung 1150 Autocut). Observations were first carried out with a Wild M420 stereomicroscope, then with optical microscope, a Reichert–Jung Polivar 100. Pictures were taken with a Moticam 2500 – 5.0 M Pixel digital camera. The anatomical section descriptions were conducted following the IAWA list of microscopic features for hardwood identification [17].

The key used for identification was elaborated by Nardi Berti and Edlmann Abbate [18]. Moreover, the evidence gathered was compared to the evidence reported in the Inside wood database [http://insidewood.lib.ncsu.edu]. The descriptions by Giordano [14] and Sweingruber [12] were consulted. A comparison was also made with a referral sample from *Cedrela* made available by Dr. Mauro Bernabei (CNR).

Upon confirmation of the results obtained by optical microscope analysis, the investigations were completed with SEM investigation. Samples were sputter-coated with gold in a Balzers MED 010 unit, and observed with a JEOL JSM 6010-LA electron microscope.

3. Results and discussion

The macro- and microscopic characteristics, which were examined in each sample, showed the homogeneity of the wood among the eleven elements. The following results from the xylologic investigation were obtained.

3.1. Macroscopic examination

The examined wood is heteroxylous, from a species that belongs to the dicotyledons angiosperms. The analysis shows that growth rings, in transversal section, are distinct, with vessels diameter greater in early-wood than in latewood. Vessels are more frequent in the latewood. These sometimes create a porous ring. The pores are solitary or multiples of 2-3 elements. Vasicentric paratracheal parenchyma cells and sometimes marginal parenchyma bands occur.

3.2. Microscopic examination

The three main sections, specifically transversal, tangential and radial sections, were observed microscopically (Figure 3).

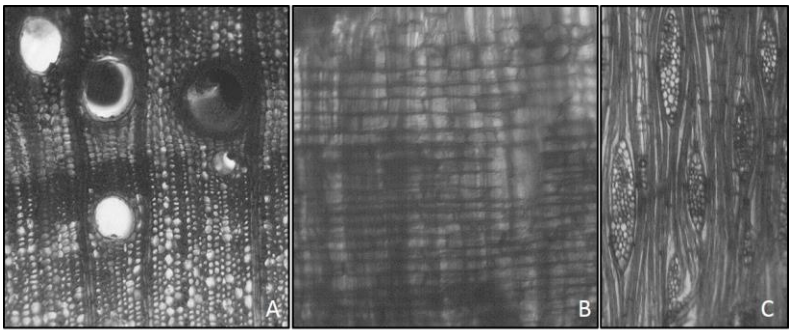

Figure 3. Section: (A) transversal - larger diameter vessels in early-wood mark the ring boundary, pluriseriate rays; (B) radial - procumbent and square cells in marginal rows; (C) tangential - pluriseriate rays.

The transversal section exhibits distinct growth rings; rings boundaries are marked by larger diameter vessels in early-wood than in latewood, and by marginal bands of parenchyma (Figure 3A). Rays are uniseriate and pluriseriate (2-3 up to 4 cell rows). Axial parenchyma is paratracheal (arranged around the vessels) mostly vasicentric, sometimes aliform or confluent. The apotracheal parenchyma also occurs, as diffuse parenchyma.

The radial section shows homocellular and heterocellular rays. Homocellular rays exhibit parenchymatics procumbent cell. The heterocellular rays show procumbent and square cells in marginal rows, which toll up to 20. Vessels show simple perforation (Figure 3B).

The tangential section shows uniseriate and pluriseriate rays for up to 4 cell rows (Figure 3C).

The SEM observations confirm the described anatomical details (Figure 4)

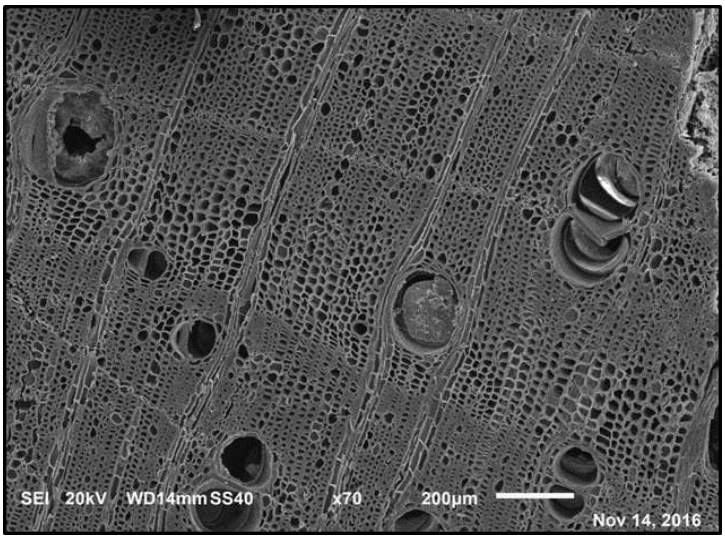

Figure 4. SEM image of the transversal section: larger diameter vessels in early-wood and thick wall cells in latewood mark the ring boundary.

The indications obtained from the analysis of the xylema allowed for the identification of the *Cedrela* genus, which belongs to the *Meliaceae* family. The wood used for the different elements of the *Jesus Nazareno* clearly derives from a tree of the *Cedrela* genus. In order to obtain further evidence for the identification of the examined samples, these were compared with the images available from the Insidewood website and with the sample of *Cedrela* wood (CNR). The comparison showed a clear match between samples.

It was more complicated to define the botanical species from the xylema types. In fact, the anatomical elements, characteristic of the various species within the *Cedrela* genus, are the same [14, p. 1248-1249; 18, p. 112; 19]. The botanical classification of the species takes into consideration also other aspects, such as the form and the dimension of the leaves or the conformation of the

reproductive organs, which are different from the anatomical characteristics of the wood [H.A. Alden, *Scientific limits of microscopic wood analysis of objects d'art*, 26th AIC Annual Meeting, Poster Session, June 1998].

The species identified in this work could plausibly be *Cedrela odorata* L. This hypothesis is supported by the geographical distribution and the traditional use of this type of wood. Therefore the identification of the genus is based on the objective evidence while that of the species remains within the realm of a hypothesis. What is more, the same common names such as 'Cedar', 'Cedro', 'Central American cedar', 'South American cedar', and 'Spanish cedar' are indifferently attributed to different species of the *Cedrela* genus. Just as the anatomical characteristics are similar, so are the technological characteristics of each species, thus being easily replaceable from one to another.

The wood has whitish sapwood and heartwood of differentiated colour, which ranges from a pinkish red to a reddish brown. The odour, which is characteristic and more or less marked according to the individual, was not detected during the analysis due to the minimum dimension as well as the oldness of the samples. The texture is generally medium or large. The grain is straight or interlocked [18, p. 112]. The heartwood is extremely durable, showing a good resistance against decay and insects. For these reasons this wood was one of the most used in the past and is still used today in different regions of Central and South America where it grows spontaneously in the tropical forests, except for Chile [15]. The cedar has been used in the past for religious art in Central and South America, as it is easy to work with especially for carving [19, 20].

Therefore, the popular attribution of the statue coming from a European context is not very probable, as it is made of wood that is of Central South American origin. In the past, the choice of wood for artistic purposes was based on essentially two factors: the availability of the wood at a local level and the technological characteristics. This species complies perfectly over the course of time with both prerequisites.

The comparison between the popular narrative and the realty of the facts, proved by scientific methods, is important so as to clarify the anthropological significance of the work [13, 15]. On the other hand, the anecdotal and/or approximate attribution could be misleading if a descriptive element of the work without any scientific evidence is given [11].

4. Conclusions

The macro- and microscopic examination of the samples, even though the samples were of a small dimension, verified that the elements that compose the statue were carved into wood of the same botanical species and this same is not a botanical species of European origin, and even less of Italian origin.

This study has allowed for the definition of the origin in function of the family and the botanical genus of the wood used for the realization of the work.

In the vegetation area of the species, the wood examined is indicated to be called Spanish cedar, due to its intense and pleasant aroma. The botanical species of the wood used in this statue may be *Cedrela odorata* L.

The information on the origin of the work is vague: someone said that the statue can be attributed to Italian production presumably Florentine, but the wood is used in central-American. The most plausible hypotheses are that the central-American wood was transported to Florence and then carved, or that the artist carved the statue directly in Central America.

The identification of the wood species has certainly contributed to shed some light on the demo-ethno-anthropological aspects of this particular processional statue, and also on the historical and artistic details of this interesting work with liturgical and devotional significance.

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