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INVESTIGATION OF SOME WOODEN DECORATED ELEMENTS AND RESTORATION OF THE CHOIR IN THE CATHEDRAL OF SAN RUFINO IN ASSISI

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Abstract

In the Cathedral of San Rufino in Assisi (central Italy) there is an interesting wooden choir, probably built between 1518 and 1527, by Giovanni di Pier Jacopo from San Severino Marche. The choir is constituted by two orders of stalls, which were reworked over time. In 2004 a restoration, completed in 2005, was undertaken in order to solve some problems caused by the loss of alignment and functionality among stalls and seats. Moreover some frames were missing; some parts were badly deteriorated due to attacks by xylophagous insects. During this intervention some erratic decorated elements with wooden marquetry were found under the choir stalls. The main results concerning the identification of the botanical species, the FTIR analysis of the surface materials and the restoration criteria are reported. Only wood from broadleaf species was found. Juglans regia (European walnut), both for the structure and for tiles, and Euonymus europaeus L. (European spindle tree) were identified as species. Other tiles were identified as belonging from Oak (gen. Quercus), and from Rosaceae (probably gen. Pyrus and Prunus). Two wood samples, different one each other, remain identified as broadleaf species. The FTIR analysis evidenced the presence of proteinaceous material. This evidence suggests that these relict elements may have originated in the first installation of the choir, before the final finishing. The recent intervention restored the alignment between the stalls and the seats, guaranteed good support for all the parts and, at the same time, the distribution of the loads in the entire structure was favoured. This work was an opportunity to gather information on some artistic techniques documented by this choir and to share them with the scientific community. In conclusion, the minimum sampling approach proved to be useful for obtaining valuable information on works of art.

Keywords: wood, species, identification, glue, minimum intervention

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1. Introduction

In the Cathedral of San Rufino in Assisi (central Italy) there is an interesting wooden choir, probably built between 1518 and 1527. This is the most important work of art of Giovanni di Pier Jacopo from San Severino Marche, preserved until today. The carver received the commission with precise instructions for the construction of the choir in 1518, but the work extended for about a decade. The backrest should have been made of grotesque carving or inlaid with perspective according to the contract, with the warning to make them different from each other. The priests undertook to supply all the wood, nails and iron, while Giovanni would have provided for the wood "per fare intarsio con fusaggine e al legname necessario per fare prospective" (to make inlay with European spindle tree and the wood needed to make prospective). He was also responsible for the recovery of wood from the old choir, glue supply and painting of the choir [1].

The choir is constituted from two orders of stalls, which were reworked over time. A radical renovation of the cathedral was planned in 1571 by the architect Galeazzo Alessi. The consolidation work changed the interior layout of the cathedral, and probably also affected the choir. In the nineteenth century the changes also affected the central area of the apse to house the great organ of 1841 by Antonio and Francesco Martinelli from Umbertide [G. Elisei, Accademia Propertiana del Subasio, I, 1895, 50-52]. In 1846 the high altar was replaced and shortly afterwards in the presbytery area four doors were opened in the niches of the dome, eliminating the corresponding altars [1].

Figure 1. The wooden choir of San Rufino in Assisi: (A) Choir with bas-relief panels and pillars (photo Saccuman), (B-D) motifs realized by means of the inlaid 'a toppo' to hidden joint by nails. Note the nail and the paper layer in (D).

Today the central stall, destined to the bishop, is lost, so the relative inlaid table with the portrait of San Rufino blessing is preserved in the Museum of the Cathedral; of the original 25 stalls, along the side walls of the apse, 22 are still remaining [1].

The stalls of the upper order are decorated with bas-relief panels and bordered by pillars (Figure 1A). The stalls are decorated with marquetry technique (‘a buio’) both for decorative frames and for representing coats of arms [2]. The panels are completed with a perimetrical frame, moulded and decorated with serial motifs realized by means of the inlaid ‘a toppo’, often applied to hide the joints using nails (Figure 1 B-D).

In 2004 a restoration, completed in 2005, was undertaken. This intervention was necessary for restoring the alignment and functionality among stalls and seats lost over time. Moreover, some frames were missing; some parts were badly deteriorated due to attacks by xylophagous insects.

In this paper the first approach aimed at identifying the main woody botanical species of the decoration elements of the stalls presented at ESRARC 2019 [3] was deepened and further diagnostic analyses were performed. In particular, in order to investigate the execution technique, a certain attention was paid to the glues used for the realization of the inlays. Furthermore, the restoration intervention is described.

For the study of wooden artefacts, a careful examination requires that, after macroscopic identification, samples can be observed under microscope. This further step is often not possible. Despite portable instruments give excellent results [4], especially for this kind of samples characterized by such small dimensions, the arrangement of the different elements makes it impossible to examine the fundamental anatomical sections *in situ*.

This study is placed within the minimum sampling intervention approach [5]. In fact the analyses were carried out on samples that derive from the choir, but which are no longer part of it.

The publication of these results is linked to the conviction that the work of art is a ‘unicum’ and that the invasiveness of the analyses must be the minimum possible. The data gathered are relevant for the restoration [6-9], but they also constitute a precious support for future studies and for desirable maintenance operations [10, 11].

2. Materials and methods

In order to identify the botanical species, the wooden pieces were carefully observed to collect information on the macroscopic features, to separate the samples into homogeneous groups [UNI 11118:2004, Cultural heritage, Wooden artefacts, Criteria for the identification of the wood species]. A stereo microscope Olympus SZ60 was used.

Based on this approach, small tiles of the marquetteries components were taken for microscope investigation, under transmitted light using Zeiss Axioskop optical microscope. The observation of anatomical features on thin sections

allowed the identification of the taxon of the wood samples [12], comparing to the description of dichotomous keys and database [13, 14].

Fourier transform infrared spectroscopy (FTIR) analysis was performed on sample powder taken from the surface of the sample shown in Figure 1B. FTIR spectrometer (Nicolet Avatar 360) was used operating in diffuse reflectance modality (DRIFT) in the 400-4000 cm^{-1} range, with spectral resolution of 4 cm^{-1}. The organic materials were identified by comparison of the obtained spectra with data from literature [15, 16], and reference spectra obtained in the laboratory.

3. Results

3.1. Diagnostic analyses

The three pieces found under the choir are parts of the moulded cornices that currently frame the finely worked panels of the stalls. These samples represent three decorative motifs that are recurrent in the choir. The wood that houses the marquetry decorations, i.e. the structure of the choir, is walnut (*Juglans regia* L.). The European walnut wood has valuable technological characteristics: it is easy to work, of medium hardness and texture, little propensity to deformation, as well as easy to finish and with an appreciated heartwood colour. It has been widely used in cabinet-making and fine furniture [17].

The observation under stereomicroscope allowed to detect the complex motifs. The combination of tiles of different colours draws the elementary geometric patterns which, repeated, form the decorative motif. To create the geometric decorative motif, 14 elements were found in sample shown in Figure 1B, 19 in samples of Figure 1C and D. These decoration patterns are delimited by two strips of light wood, sometime a dark thinner strip is added. The naked eyes inspection, recording each feature, allowed recognizing the repetition of seven groups of tiles with homogeneous characteristics. The more reliable feature was colour, as the observation of the macroscopic features was performed on the surfaces without any modification to enhance the visibility. Non-anatomical features, such as colour, are known to undergo natural variations over time, for example due to exposure to light [18-20] or degradation phenomena of biological origin [21]. However, due to the type of ornamental motifs, the colour of the wood, natural or modified *ad hoc*, was a fundamental element for the decorative result.

These serial motifs were realized by means of the inlaid ‘a toppo’. This term indicates a parallelepiped consisting of strips of different woods, longer than thick. The horizontal assembly of the small strips of different colours, shaped to form a geometric pattern, is repeated for the length of the entire motif. Then the strips are glued with mastic or other adhesives, such as proteic glue. The composite element is sectioned longitudinally, thus obtaining a series of thin strips where the original motif is repeated several times to obtain the necessary length [22].

A layer of paper was detected below one of the decorated strips (Figure 1D). Probably on the strip of paper there are traces of pencil to draw some lines for the positioning of the tiles. The paper layer was fluorescent to ultraviolet radiation, maybe because it is impregnated with glue.

Only woods from broadleaf species were found. Some wooden elements were identified at the species level: *Juglans regia* (European walnut), both for the structure and for tiles, and *Euonymus europaeus* L. (European spindle tree). Other tiles were identified as belonging from Oak, probably European oak, (gen. *Quercus*), and other two different *Rosaceae* (probably gen. *Pyrus* and *Prunus*). Two other wooden group of elements were detected, from broadleaf species different one each other not better identified for the lack of diagnostic elements.

The wood of European spindle tree is clearly indicated in the contract proposed to Giovanni by the priests [1]. The spindle is a little tree tall 4-5 m with diameter around 15-20 cm. The wood is light coloured, with high hardness, easy to finish and with an appreciated light colour. It was used in inlay and turning [17, p. 118].

Oak wood in this choir is dark coloured. Probably is ‘quercia annegata’ (drowned oak), that is a partially fossilized wood, remained for long time in water to take a very dark colour, almost black, used in substitution of the ebony, much more expensive and difficult to find [22, p. 44; 23].

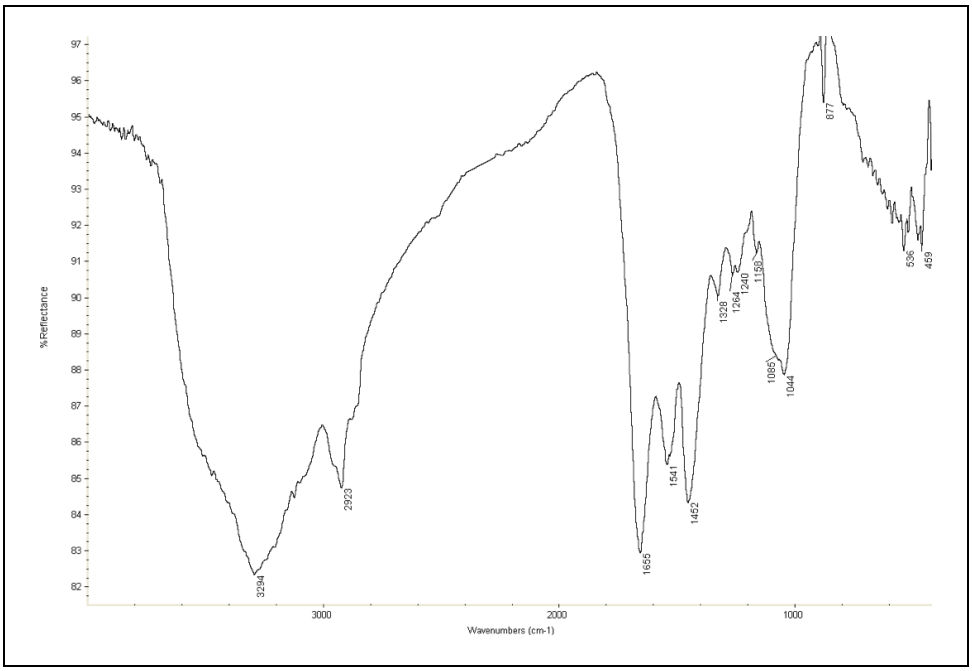

Figure 2. FTIR spectrum of the inlay surface.

In the works of art, from altar machines [24] to furnishings for domestic, political or religious purposes [8, 10, 25], the artists paid great attention to the choice of the wood species, often selecting different species both for their decorative effects, but also in relation to their durability.

The reasons can be primarily attributed to the high variability of the colour and of the technological characteristics of the different botanical species. These characteristics affect the aesthetic result, but also the conservation and restoration interventions [26, 27], since the behaviour of the wood from different botanical species is different concerning the biotic and abiotic agents.

FTIR analysis identifies the presence of a binder proteinaceous (Figure 2). In particular the amide I bands at 1655 cm^{-1} (C = O stretching band), amide II at 1541 cm^{-1} (C-N-H bending band) and amide III at 1452 cm^{-1} (C-H bending band) are evident in the FTIR spectrum. The FTIR spectrum also recognizes the other protein characteristic bands at 1240, 1160, 1085 and 1044 cm^{-1} [15; 16, p. 102]. It is interesting to note that the finishing product presence, waxes, oils or shellac, was not indicated in the FTIR analysis [19]. This evidence suggests that these relict elements may have originated in the first installation of the choir, before the final finishing.

3.2. Restoration

An accurate cleaning of the dust and debris accumulated was carried out in the less accessible parts of the choir such as the back and above the cornice where there were still many debris dating back to old works on the church walls.

To eliminate the layers of waxes, oils and hardened powders that covered the wood, a solution based on ammonium bicarbonate in water was suspended, with the addition of 10% carboxymethylcellulose used in the most appropriate dilution, depending on the layer thickness to be removed, in full respect of the original patina of the wood. It was applied using compresses on absorbent paper, in order to make its removal easier.

The lower part of the choir from the platform to the backrest, excluding the postergals and the cornice, was disassembled to allow the restoration of the supporting structures of the choir. The oak beams, which formed the main structure, were supported only in part on stones and wooden wedges, some of which are no longer in position. This lack of supports determined the deformation of the entire choir, which was the reason for requiring the intervention. A concrete support base was built, taking care to not change the asset of the architectural structures. The new supports consist of steel bases that end with an anti-vibration support on the ground, while oak bases, treated with preservatives, were applied in contact with the original wood. The metal parts were also treated with galvanic protection. In this way the alignment between the stalls and the seats was almost completely restored, good support was guaranteed for all the parts and at the same time the distribution of the loads in the entire structure was favoured.

The rehabilitation operations on the disassembled parts were conducted more easily. In the fissures of the panels walnut wedges were introduced from the rear, the same species as the original one. To restore the functionality of the folding seats, the addition that raised the seats was removed. The missing frames were reconstructed according to the existing modules (Figure 3A). In the reconstruction operation the two wooden panels connecting the organ were not reintegrated, in order to highlight the modification made on the choir over the past centuries. After cleaning, the consolidation of the elements most degraded by xylophagous insects was carried out by impregnation with acrylic resin in a 7% solution (Paraloid B72 in nitro diluent); the disinfestation was operated with Permetar applied by brushing on the front and by spraying on the surfaces difficult to reach. The grouting (Figure 3B) was carried out in the most degraded areas with wood pulp and finished with a plaster stucco and rabbit glue in the decorated parts of the inlays. The chromatic connection of the elements was made with natural mordant in aqueous solution, applied by glazing on the new wooden parts. The final protective treatment was applied manually with a generous spread of beeswax dissolved in turpentine and then polished with brushes and woollen cloth.

Figure 3. (A) Grouting in the decorated parts of the inlays and in the frames, (B) the choir during restoration (photo R. Saccuman).

4. Conclusions

The present paper reports the investigation on some erratic decorated elements with wooden marquetry found under the choir stalls of the Cathedral of San Ruffino in Assisi (Italy).

Only woods from broadleaf species were found. *Juglans regia* (European walnut), both for the structure and for tiles, and *Euonymus europaeus* L. (European spindle tree) were identified as species. Other tiles were identified as

belonging from Oak (gen. *Quercus*), and from *Rosaceae* (probably gen. *Pyrus* and *Prunus*). Two woods, different one each other, remain identified as broadleaf species.

The discovery of erratic elements, unquestionably belonging to the choir, was an interesting opportunity for the microscopic identification of wood species in this historic work of art, which otherwise would have been impossible.

The discovery of the relic elements, found under the choir at the time of the restoration in 2004, allowed to investigate thoroughly with analyses that could never have been carried out on the choir itself. In fact, the microscopic investigation substantially implied the destruction of some pieces of the decorative motifs, for the identification of the botanical species. Precisely the removal of the tiles from the samples to carry out the analyses revealed the presence of a layer of paper that had not been observed at a first macroscopic examination. FTIR allowed for detecting the presence of protein glue, probably the so-called *colla forte*.

The criteria that guided the restoration work have been described.

The authors hope that these results will be able to avoid invasive investigations in the future. Certainly, they have been an opportunity to give information on some artistic techniques documented by the investigated artefact.
In conclusion, the minimum sampling approach revealed useful for obtaining valuable information on artworks.

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