

THE POLYCHROME WORKS “PRAYER OF TOBIAS AND SARAH” AND “THE ARCHANGEL RAPHAEL REVEALS HIMSELF TO TOBI AND HIS SON TOBIAS”, INSIDE THE CATHEDRAL OF COSENZA: DIAGNOSTIC INVESTIGATIONS AND CONSIDERATIONS ON THE CONDITIONS OF CONSERVATION

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1. Introduction

The restoration of the paintings *Prayer of Tobias and Sarah* and *The Archangel Raphael reveals himself to Tobi and his son Tobias*, has offered the opportunity to lead a major scientific investigation to obtain information on materials used by the author. These paintings are Calabrian works of eighteenth century, kept in the cathedral of Cosenza.

The origins Cathedral of Cosenza are unknown. It was destroyed by an earthquake and the rebuilding was started in 1185 on the Pancrazio Hill. It was completed by 1222 when the Duomo was consecrated by Emperor Frederick II. In the first half of the 18th century it was covered by a baroque superstructure which obliterated the original structure and its works of art. At the



Figure 1. The facade of Cathedral of Cosenza.

end of the 19th century, Archbishop Camillo Sorgente entrusted the work to Giuseppe Pisanti, who recovered the original old arches and the ancient structure of the church (fig. 1). In the Cathedral there is the tomb of the Queen Isabella d'Aragona, wife of the French King Philip III. In the Treasury of the adjacent Archbishops Palace is the rare and precious Stauroteca (Byzantine Cross) of the emperor Frederick II. It was a gift of the Emperor Frederick II to the Cathedral upon consecration [1-5].

The purpose of this study was to obtain a physical-chemical description of the organic and inorganic compounds, the stratigraphic sequence, the pigments and binders used in these paintings to clarify the execution technique of the paintings, their state of conservation and the aging process. Such a survey thus offered an appropriate Scientific tool useful for carrying out a proper restoration.

The works "Prayer of Tobias and Sarah" and "The Archangel Raphael reveals himself to Tobi and his son Tobias" are two oil paintings on oval shaped canvas and having size 120 × 77 cm. They were attributed by Favorita Iannace of the Calabrian Superintendent for Etnoantropologico Artistic and Historical Heritage (PSAE) to Calabrian painter Francesco Bruno. The works depict episodes from the life of Tobias, the protagonist of the homonymous deutero-canonical book of Sacred Scriptures to which is dedicated an entire cycle of works attributed to the same Bruno and that is kept in the Cathedral of Cosenza.

The paintings are placed inside the chapel of the Most Holy Sacrament and located behind the left nave of the cathedral, more precisely between the chapel dedicated to the city protector, Madonna of Pilerio, and the sacristy.



Figure 2. "Prayer of Tobias and Sarah": initial state (on the left) and final state (on the right).

Figure 3. "The Archangel Raphael reveals himself to Tobi and his son Tobias": initial state (on the left) and final state (on the right).



The paintings are shown in figures 2 and 3.

The paintings as far as formal, style, color and iconographic relations are concerned they perfectly reflect the productive artistic of cultural ambient they relate to. As regards the lighting balance, Bruno shows a wise use of the palette with careful attention to details related to a meticulous representation of perimeter ornaments of garments. This is the case of the details in the two paintings when Bruno expresses a good level of the pin traits and garment embroidery of both figures representing the Archangel and the embroidery executed on the board as Sarah's garment. Even the drapery nuances symbolize quantity of their volumes.

The chapel, built in 1689, belonged to the "Archiconfraternity of Oration and Death", as evidenced by the emblem with the skull placed at the centre of the apse arch. It is shown in fig. 4. The current state of the chapel is not the original one: it was rebuilt in 1756 and restructured in Baroque style. It is more likely that most of the chapel artistic works were made in this period.

The central altar, made in polychrome marble



Figure 4. Picture of Chapel of "Archiconfraternity of Oration and Death".

Neapolitan Baroque style, was erected in 1771. Such date is carved at the base of the altar itself, which shows similarities for the formal, stylistic and iconographic traits with that of the contiguous chapel of the Pilerio.

On the apse side walls two canvases are placed. One is placed on the left of the altar and it represents "The Archangel Raphael with Tobias in the act of cutting a fish". It is dated eighteenthth century and attributed to F. Bruno. A second canvas is placed on the right of the altar and depicts "Tobi who drags a dead man to burial". It is signed by F. Bruno A.D. 1765.

On the vault of the apse is painted *The Pietà*. It is dated eighteenth century and by unknown author. On the vault of the nave there is a large eighteenth century canvas depicting a scene from the second book of Maccabees, where the inscription "Sancta et salubris east cogitatio pro defunctis exorare ut to peccatis solvatur" is reported [6]. On the sides of the aisle, placed against the walls, finely carved and decorated are arranged the stalls, works by masters of Cosenza of that century, where the brothers used to sit. Attributed to the same hands is the pulpit at the right of the altar [7].

On the walls behind the stalls four oval canvases are placed: two on the left looking at the altar, depict "Tobi regains his sight" and "Prayer of Tobias and Sarah", the other two canvases on the right depict "The Archangel Raphael reveals himself to Tobi and his son Tobias" and "The Return of Tobias".

A documentary search – about two paintings that are the subject of our discussion – was conducted at the Archive of the Superintendence for Architectural Heritage and Landscape of Calabria, seat of Cosenza, and has led to the discovery of two photos of 1973 that testify the execution of a previous restoration.

It was necessary to realize a new photographic documentation to define the conservation state of the works before the restoration intervention. The paintings showed an advanced state of deterioration that has made it necessary a marked recovery intervention. At an first visual inspection the canvases appeared to be damaged in both the protective film, which was uneven and oxidized, and in the pictorial layer, that was characterized by exfoliation, fragmentation, vacancies and by the typical *craquelure* structure.

2. Experimental section

Infrared reflectograms were taken using a 2.0 Mpixel system multiple IR and UV high resolution DG 1 multispectral instrument equipped with a precision TV infrared camera and a NIKON F1,2:50 mm lens, in front of which an interference filter at was placed. Image capture and digitisation procedure was controlled through special software.

Table 1. Legenda of the samples taken out of the painting: "The Archangel Raphael reveals himself to Tobi and his son Tobias".

| Sample | Sample description |
|---------------|--|
| CPA1 | Blue coloured micro-fragment taken from the inferior part of the garment of the Archangel Raffaele |
| CPA2 | Flesh-colour micro-fragment taken the right arm of the Archangel Raffaele |
| CPA3 | Micro-fragment taken from o cloud |
| CPA4 | Red coloured micro-fragment taken from the garment of Tobia |

IR reflectography exploits the characteristic of infrared frequency radiation to cross the painting surface layers; it thus has the possibility to investigate the layer immediately underneath the pictorial film and bring to light the preparatory drawing or any second thoughts [8, 9].

Micro collecting was carried out on the two works in the areas that showed higher signs of degradation and thus where it was easier to remove fragments for the laboratory survey. The legenda of the drawings made on the two works is shown in tables 1 and 2.

The IR analysis on the samples were made using the FT-IR Jasco 4200 spectrometer with a maximum resolution of 0.5 cm⁻¹ and signal noise 30000/1. The IR spectroscopy is an analytical technique used frequently enough to characterize the materials coming from the works of art, especially the compounds of organic origin [10]. In our case it has been used successfully, providing valuable information regarding the materials and techniques used by the artist.

Some of the fragments taken were observed after embedding in resin and cut, in

Table 2. Legenda of the samples taken out of the painting: "Prayer of Tobias and Sarah".

| Sample | Sample description |
|---------------|---|
| CPB1 | Green coloured micro-fragment taken from the garment of Tobia |
| CPB2 | Red coloured micro-fragment taken from the garment of Tobia |
| CPB3 | Black coloured micro-fragment taken from the background |
| CPB4 | Blue coloured micro-fragment taken from the garment of the Archangel Raffaele |

cross section, in order to describe the stratigraphic sequence. The analysis was carried out through a Leica MZ 12.5 stereoscopic system operating in reflected light. Scanning electron microscope (SEM) analysis was carried out to obtain morphological and chemical data. The apparatus was an Esem Quanta 200 by Fei/Philips coupled with an energy dispersive X-ray spectrometer (EDS). EDS microanalysis was performed in order to obtain information on the elemental compositions of the samples [11-12].

3. Results and discussions

IR reflectography investigations were carried out on significant portions of the two paintings. For each portion were used IR filters 715, 830 and 1000 nm. Two evidences of Bruno pentimenti have been identified on the painting "Prayer of Tobias and Sarah" on the

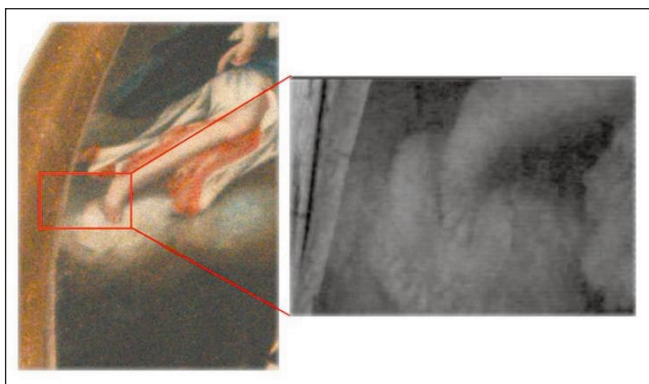


Figure 5. Image in visible light (on the left) and IR (on the right) of the particular of the Archangel's shoulder.

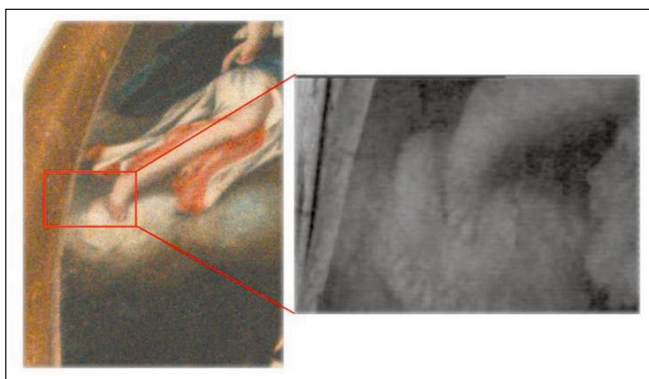


Figure 6. Image in visible light (on the left) and IR (on the right) of the particular of the Archangel's foot.

Archangel Raphael right foot and right shoulder respectively.

Visible light and Infrared Images of the painting details are shown in figures 5 and 6 where the pentimenti are present. In the images concerning the detail of the Archangel Raphael right shoulder it is clear the initial pentimento of the artist in the preparatory phase being possible to observe in the image collected in IR, the presence of a riser on the Archangel shoulder that disappears in the final painting.

The IR image of the Archangel Raphael foot shows how the artist's repentance was conducted on the same pic-

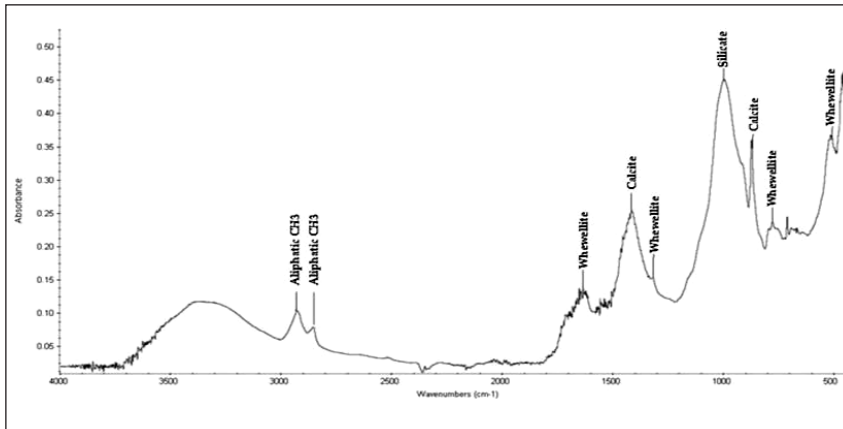


Figure 7. IR spectrum relative to the sample CPA3.

torial drawing. It is hardly observable with the naked eye. The pentimento is characterized by a translation of the Archangel right foot and the IR image proves how the artist had reduced the lower part of the Archangel figure.

A fragment of the CPA3 sample was analyzed by FT-IR spectroscopy. In the spectrum, shown in figure 7, are distinguishable the stretching of methyl groups (2930 cm^{-1} and 2850 cm^{-1}) which indicate the presence of organic matter, the characteristic frequencies of calcite (1400 cm^{-1} and 890 cm^{-1}), the intense band related to silicates located at 1000 cm^{-1} and finally the signals typical of the whewellite $\text{Ca}(\text{C}_2\text{O}_4) \cdot (\text{H}_2\text{O})$, an hydrated mineral of the calcium oxalate, a typical product of the organic matter degradation [13-14].

It is noteworthy that the absence of signals relating to amines and gypsum. This result excludes that the preparation was made through the traditional mixture of gypsum and animal glue.

The FT-IR analysis is unable to provide further information about the organic compounds present as the frequency characteristics of the various compounds are “masked” by the absorption of inorganic materials. Through the observation of cross-section by an optical microscope in reflected light at 100X magnification (fig. 8), it was conducted the stratigraphic analysis of the paintings that made it possible to locate the following sequence of layers:

- 1) light brown coloured canvas fraction;
- 2) yellow preparation layer with variable granulometry having thickness between 100 and 300 μm ;

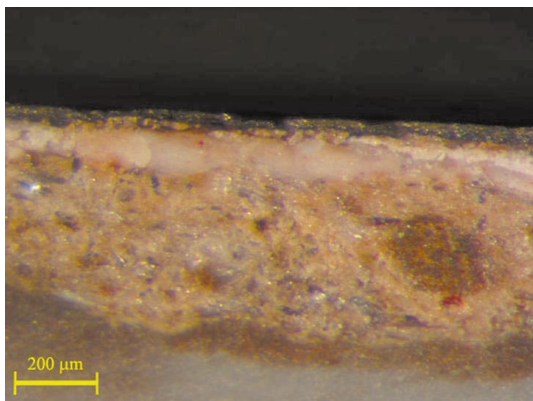


Figure 8. Image on the microscope of the sample CPA2.

- 3) pictorial layer having variable thickness between 40 and 130 μm ;
- 4) thin layer of brownish coloured paint.

All sections observed have the same stratigraphic succession, but differ in the nature of pigment in the pictorial layer. On cross-section morphological investigations and elemental analysis were carried out through the SEM microscope. The elemental analysis on the A1 sam-

ple shows a high percentage of lead, while sodium, aluminum, silicon and sulphur are present in smaller quantities. Lead indicates the presence of white lead (basic lead carbonate $2\text{PbCO}_3 \cdot \text{Pb(OH)}_2$) while the molar relation between Na, Al, Si and S indicate the presence of Ultramarine Blue, an artificial blue pigment similar to lapislazuli.

The sample CPA2 is essentially composed of lead, while in smaller quantities are present sodium, magnesium, aluminum, silicon, chlorine, potassium, calcium and iron. As for the sample CPA1, lead indicates white lead pigments, while the presence of Al, Si and Fe individuates Yellow Ochre which are pigments of mineral origin consisting of silica, silica-alumina compounds and iron oxides, used for the preparation of the flesh-colour [15].

This is due to the modest quantities, which are not well recognizable by the instrument. However, it can be assumed that in preparing the flesh-colour it has been also used the Cinnabar pigment. The elemental analysis on the CPA4 sample highlights the presence of mercury and sulphur and, on the basis of their molar relation indicates the presence of Cinnabar. In the CPB1 sample the presence of white lead is found, while molar relations between Mg, Al, Si, K and Fe indicate the presence of Terra Verde; a pigment of mineral origin composed of a mixture of two- silica-alumina Fe (II) Mg and K.

In the sample CPB3 the presence of white lead is not found, the percentage composition of the items listed in the table (tab. 3) cannot be related to specific pigments. The high peak related to carbon in the EDS spectrum, despite it is not quantitative, suggest the presence of an organic or carbonic pigment such as graphite or Flame Black. In the pictorial layer of the sample CPB4 it has been found the presence of white lead and

Table 3. Summary table of the analyses carried out through SEM-EDS (the compositions are expressed as molar percentage).

| Localization | Al | Si | P | S | Pb | Cl | Hg | Ca | Na | Fe | Pigment identification |
|---------------------|------|------|-----|------|------|-----|------|------|-----|-----|------------------------------------|
| A1, pictorial layer | 5.3 | 15.3 | – | 7.5 | 62.7 | 1.3 | – | 4.8 | 3.1 | – | Lead white, Ultramarine Blue |
| A2, pictorial layer | 2.5 | 10.8 | – | 7.6 | 59.1 | 1.7 | 1.1 | 4.7 | 4.2 | 4 | Lead white, Cinnabar, yellow Ochre |
| A4, pictorial layer | 4.7 | 14.1 | – | 19.6 | 4.7 | 7.1 | 16.6 | 16.6 | 8 | 2.7 | Lead white, Cinnabar |
| B1, pictorial layer | 6.2 | 11.9 | – | – | 22.3 | 3.2 | – | 36 | – | 2.4 | Lead white, Terra Verde |
| B3, pictorial layer | 9.3 | 35.9 | 0.8 | – | 4.5 | – | – | 29 | – | 8.3 | Organic brownish pigment |
| B4, pictorial layer | 16.5 | 25.8 | – | – | 27 | 3.5 | – | 8 | – | 5.9 | Lead white, Ultramarine Blue |

Ultramarine Blue. The pigments identified by SEM-EDS in the various samples are summarised in tab. 3.

For the morphological analysis of the preparation, samples CPA1 and CPB1 were taken into consideration as representative of both works. In both them, the SEM and SEM-EDS techniques have revealed a carbonatic fine grain matrix preparation (fig. 9). It is also possible to note mineral crystals, microfossils and plant material even through visual analysis.

4. Conclusions

The diagnostic investigations carried out on paintings have helped to highlight some elements of the author technical executive either through non-

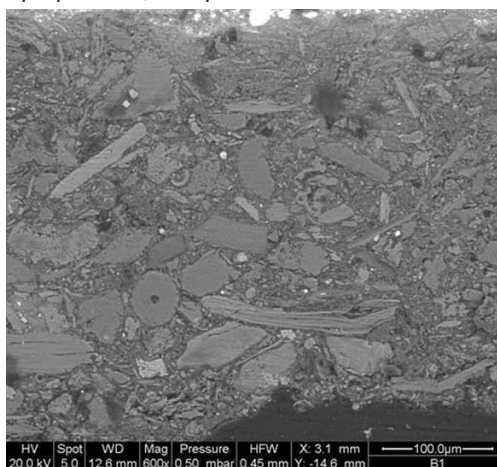


Figure 9. Image on the SEM of the sample CPB1 at 600X.

invasive methods or invasive. The reflectography highlighted some repentances on the canvas Prayer of Tobias and Sarah, while invasive analysis made it possible to locate the stratigraphic sequence of each canvas and to characterise the constituent materials. The preparatory layer presents a carbonate matrix with clusters of siliceous nature, microfossils and plant material. The pigments used in the pictorial layer are ultramarine blue, cinnabar, green earth, yellow ochre and white lead. The latter pigment was abundantly used for the preparation of almost all pictorial sections.

The synergy between the various professionals within the team that performed the work of conservation and restoration, has helped to achieve a good result. On this purpose it was necessary to duly consider all the complex variables deriving from the recognition of the constituent materials of the works under consideration.

In such way, it is possible to make a re-establishment of "art work system" considering all its peculiarities, including those related to the choices made by the author at the time of its conception, the reflection of the time distinctive characters, and the knowledge of their inevitable interaction. The use of products and techniques in intervention, in fact, takes into account the future actions that can intervene on such artefacts.

This consciousness has oriented certain branches of conservation theory. Today, one of the main challenges is perhaps posed by the pervasive idea that, while conservation works "for the future" – and on this base the criteria of minimum intervention, reversibility, recognizability, have been developed – interpretation is "for the present". This approach has influenced the development and application of criteria like consensus, inclusiveness and accuracy.

The axioms of recognizability, reversibility and minimum intervention were the exclusive and founding peculiarity of the use of techniques and materials [16]. These actions were of course, envisaged also for those conditions unfit for their proper conservation, inside the places of worship for which the works were conceived. The temperature and relative humidity parameters in the chapel dedicated to Death and Prayer in the Cathedral of Cosenza, as it happens in most places of worship in our country, are not suitable for the proper conservation of the artistic artefacts in general. The interventions perspective and feasible techniques to keep in optimum such parameters for the conservation of art works, is very broad and diversified. As far as we know, instead of reclaiming by using de-humidifiers, it could be of great help to adopt such passive remedies as insulation through windows that guarantee a higher isolation of indoor environments. It is therefore important to solve this problem that has long been debated by the whole scientific community of the international restoration.

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Summary

The oil paintings and "Prayer of Tobias and Sarah" and "The Archangel Raphael reveals himself to Tobi and his son Tobias", executed by Francesco Bruno at the end of the XVIII century on oval

shaped canvas, were investigated by integrated physico-chemical and analytical methodologies in order to obtain scientific data capable of elucidating the state of conservation and the painting technique.

Optical (OM) and electronic (SEM-EDS) microscopy, micro-FT-IR spectroscopy, were applied on some microfragments whilst the two whole paintings were analyzed by the non invasive IR reflectography technique.

The reflectography evidenced some pentimenti of author on the canvas "Prayer of Tobias and Sarah", while invasive analysis made it possible to locate the stratigraphic sequence of each canvas and to characterise the constituent materials.

Riassunto

Le opere "Preghiera di Tobia e Sara", "L'Arcangelo Raffaele si rivela a Tobi e a suo figlio Tobia" sono due dipinti olio su tela di forma ovale ed aventi dimensioni cm 120 x 77, attribuiti al pittore calabrese Francesco Bruno (XVIII secolo). Le opere raffigurano episodi della vita di Tobia a cui è dedicato uno intero ciclo di opere attribuite allo stesso artista e custodite nel duomo di Cosenza.

L'articolo raccoglie l'analisi diagnostica dello stato di conservazione delle opere prima dell'intervento di restauro, effettuata mediante l'utilizzo di diverse tecniche chimico-fisiche ed inoltre alcuni cenni sulla metodologia d'intervento. Lo scopo di questo studio è stato quello di ottenere una descrizione chimico-fisica dei composti organici ed inorganici, la sequenza stratigrafica, i pigmenti impiegati e i leganti utilizzati in queste opere pittoriche per chiarire la tecnica di esecuzione dei dipinti, il loro stato di conservazione e il processo di invecchiamento. Tale indagine ha quindi offerto un appropriato mezzo scientifico utile per la corretta esecuzione del restauro.

Résumé

Les oeuvres "Preghiera di Tobia e Sara", "L'Arcangelo Raffaele si rivela a Tobi e a suo figlio Tobia" sont deux peintures à huile sur toile de forme ovale et ayant des dimensions 120 x 77cm, attribuées au peintre calabrais Francesco Bruno (XVIII^{ème} siècle). Les oeuvres représentent des épisodes de la vie de Tobia auquel est consacré un cycle entier d'œuvres attribuées au même artiste et gardée dans le dôme de Cosenza.

L'article recueille l'analyse diagnostique de l'état de conservation des oeuvres premières de l'intervention de restauration, effectuée moyennant l'utilisation de diverses techniques chimico-physiques et, en outre, quelques aperçus sur la méthodologie d'intervention. Le but de cette étude a été celui d'obtenir une description chimico-physique des composés organiques et inorganiques, la séquence stratigraphique, les pigments employés et les liants utilisés dans ces oeuvres picturales pour clarifier la technique de réalisation des peintures, leur état de conservation et le processus de vieillissement. Cette recherche a donc offert un approprié moyen scientifique utile pour la correcte réalisation de la restauration.

Zusammenfassung

Die Werke "Gebet von Tobias und Sarah" und "Der Erzengel Raphael offenbart sich dem Tobit und seinem Sohn Tobias" sind zwei Ölgemälde auf einer ovalen Leinwand, mit Größe 120 x 77 cm, die dem kalabrischen Maler Francesco Bruno (XVIII. Jahrhundert) zugeschrieben sind. Die Werke stellen einige Episoden aus dem Leben von Tobias dar, dem ein ganzer Zyklus von Werken gewidmet ist. Solche Werken sind dem selben Maler zugeschrieben und sind im Dom in Cosenza verwahrt.

Der Artikel berichtet über die diagnostische Analyse des Erhaltungszustands der Werke vor dem restauratorischen Eingriff, bei dem verschiedene chemische-physikalische Techniken angewendet wurden. Außerdem deutet der Artikel kurz auf die Methodologie des Eingriffs an. Das Ziel dieser Studie war es, eine chemische-physikalische Beschreibung der organischen und anorganischen Verbindungen zu haben, zusammen mit Informationen über die stratigraphische Sequenz, die angewendeten Pigmenten und die Bindemittel dieser malerischen Werke, um die Technik der Gemälde,

deren Erhaltungszustand und den Alterungsprozess zu erklären. Diese Untersuchung stellt also ein geeignetes wissenschaftliches Mittel für die korrekte Durchführung der Restaurationsarbeiten dar.

Resumen

Las obras "Oración de Tobías y Sara", "El Arcángel Rafael se revela a Tobi y a su hijo Tobías" son dos pinturas al óleo sobre lienzo, de forma oval y con unas medidas de 120 × 77 cm, atribuidas al pintor calabrés Francesco Bruno (siglo XVIII). Las obras representan episodios de la vida de Tobías, a quien se dedica un ciclo completo de obras atribuidas al mismo artista y conservadas en la catedral de Cosenza.

El artículo recoge el análisis diagnóstico del estado de conservación de las obras antes de la actuación restauradora, efectuada mediante el uso de distintas técnicas químico-físicas, incluyendo además algunas datos sobre la metodología de intervención. La finalidad de este estudio ha sido la de obtener una descripción químico-física de los compuestos orgánicos e inorgánicos, la secuencia estratigráfica, los pigmentos empleados y las sustancias ligantes utilizadas en estas obras pictóricas para aclarar la técnica de ejecución de las pinturas, su estado de conservación y el proceso de envejecimiento. Este estudio ha ofrecido un medio científico apropiado y útil para la correcta ejecución de la restauración.

Резюме

Произведения «Молитва Тобия и Сары» и «Явление архангела Рафаэля Тоби и его сыну Тобию» - это две картины, выполненные маслом и имеющие овальную форму размером 120X77 см. Они приписываются калабрийскому художнику XVIII в. Франческо Бруно (Francesco Bruno). Эти произведения изображают эпизоды жизни Тобия, которому посвящен целый цикл произведений, приписываемых этому же художнику и находящихся в соборе Козенцы.

В статье представлен диагностический анализ степени сохранности произведений до проведения реставрационных работ. Этот анализ был проведен при использовании различных химико-физических методов. В статье описана также методика реставрационных работ. Целью этого исследования было получение химического и физического описания органических и неорганических соединений, анализ стратиграфического ряда, используемых пигментов и вяжущих материалов. Все это необходимо для понимания техники выполнения этих картин, степени их сохранности и процесса старения. Таким образом, это исследование дало необходимые научные данные для правильного проведения реставрационных работ.