

An Analytical Study Of A Polychrome Wooden Coffin Of Tayuheret's Mummy Dating Back To The Third Intermediate Period. (1054-1046 B.C).

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Abstract

This study aims to identify the anatomical and stratigraphic structure of the components of one of the polychrome wooden coffins dating back to the third intermediate period and currently preserved in the Egyptian Museum in Cairo.

The wooden coffin, the subject of the study, represents an important stage in the development of wooden coffins during ancient Egyptian times, especially in the Third Intermediate Period, when the manufacturer used the best imported wood, the Lebanese cedar.

The manufacturer carved the wooden coffin in the form of cedar wood covered with a layer of gypsum. used many color components such as yellow in the floor, in addition to the Egyptian blue, green, black and red.

The wooden coffin is in a good condition of preservation, and the researcher used some types of modern scientific methods to examine and analyze the multicolored wooden coffin using scanning electron microscope (S.E.M), X-ray diffraction(XRD), as well as analysis using Fourier infrared spectroscopy(FTIR).

The results indicated that the ancient Egyptians used imported cedar wood and red ocher (also known as hematite) to obtain the red color and cadmium oxide for the yellow color and some other colors such as black, green and Egyptian blue on the gypsum holder. The wooden coffin and on the lid of the coffin itself, animal glue adhesive was used between the components and particles of the preparation layer, as well as the parts of the chromatic layer examined during this study.

Keywords

Polychrome wooden coffin; The Third Intermediate; Pigments; SEM-EDX; XRD; FTIR.

الملخص

تهدف هذه الدراسة إلى التعرف على التركيب التشريحي والطبقي لمكونات أحد التوابيت الخشبية متعددة الألوان التي يعود تاريخها إلى عصر الانتقال الثالث والمحفوظ حاليًا بالمتحف المصري بالقاهرة.

يمثل التابوت الخشبي ، موضوع الدراسة ، مرحلة مهمة في تطور التوابيت الخشبية عبر العصور المصرية القديمة ، خاصة في عصر الانتقال الثالث ، عندما استخدم الصانع والفنان أفضل الأخشاب المستوردة وهو خشب الأرز اللبناني.

وقد تم نحت التابوت الخشبي من خشب الارز على شكل آدمى والتابوت مغطى بطبقة من الجبس. استخدم الصانع العديد من الألوان مثل الأصفر في الأرضية ، بالإضافة إلى الأزرق المصري والأخضر والأسود والأحمر.

التابوت الخشبي بحالة جيدة من حيث الحفظ ، رغم العرض في الظروف البيئية غير الجيدة والمناسبة للعرض المتحفي وقد استخدم الباحث بعض أنواع الأساليب العلمية الحديثة لفحص وتحليل مكونات التابوت الخشبي متعدد الألوان باستخدام

الميكروسكوب الإلكتروني الماسح (S.E.M)، تحليل حيود الأشعة السينية (XRD)، وكذلك التحليل باستخدام مطيافية الأشعة تحت الحمراء (FTIR).

أشارت النتائج إلى أن قدماء المصريين استخدموا خشب الأرز المستورد والمغرة الحمراء (المعروفة أيضًا باسم الهيماتيت) للحصول على اللون الأحمر وأكسيد الكاديوم للون الأصفر وبعض الألوان الأخرى مثل الأسود والأخضر والأزرق المصري على حامل الجبس. تم استخدام التابوت الخشبي وعلى غطاء التابوت نفسه، لاصق الغراء الحيواني بين مكونات وجزيئات طبقة التحضير، وكذلك أجزاء الطبقة اللونية التي تم فحصها خلال هذه الدراسة.

الكلمات المفتاحية

تابوت خشبي متعدد الألوان، عصر الانتقال الثالث، المواد الملونة، الميكروسكوب الإلكتروني الماسح، حيود الأشعة السينية، التحليل بمطياف الأشعة تحت الحمراء.

Introduction

The ancient Egyptian faith believed that protecting the body after death was vital. Preserving the body is one of the most important priorities for the deceased to reach immortality and to enter the fields of "Iaru" or heaven in the netherworld. Hence, Egyptians had to endure a lot to preserve the body by completely isolating it from the surrounding environment by painting the body with embalming materials and using linen dipped in resin. Furthermore, wrapped the body in linen rolls of different shapes and properties. The wooden coffin underwent a lot of phases of development in order to serve the religious and ideological beliefs of the Egyptians. Wooden coffins had started off simple in form but later developed tremendously, especially by the New Kingdom and Late Period {1}.

In the Old Kingdom, the shape of the wooden coffin was simple and often a rectangular wooden box barren of decorations or inscriptions but later by the late Old Kingdom, it was inscribed with formulas of religious texts from the Book of the Dead {2}.

By the Middle Kingdom, the ancient Egyptians began to replace the usual shape of the rectangular wooden coffin decorated with religious texts to become more complicated and having compact shapes on the body of the deceased. Thus, they began using wooden coffins in the form of a human figure.

By the New Kingdom, the ancient Egyptians used wooden human-shaped coffins decorated with a large pair of wings on both royal and non-royal coffins. These coffins wore a headdress, collar, and a false beard, reflecting the black image of Osiris as the owner of the coffin. Fittingly, this lined with the Osirid elements of fertility and re-birth {3}.

During the Ramesside period, the characteristics of "Osiris" remained human, then later changed into a yellow background like a sarcophagus mentioned in this study. It often contained texts that include spells from the Book of the Dead, accompanied by illustrated passages of deities and symbols of protection. These yellow coffins were in use from the beginning of the Middle kingdom until The third intermediate era, later went through a series of changes {4}.

Decoration became simpler until the advent of cardboard as an alternative to coffin lids.

1.1. Historical and archaeological background

Tayuheret coffins: (1054-1046 B.C).

Provenance: DB 320.

Discovery Date: possibly 1860 (Official registered discovery 1881).

Current Location: Egyptian Museum in Cairo CG61032.

Biographical data: "Tayuheret" was probably the wife of high priest "Masaharta".

Details: *Tayuheret* mummy was found in a set of two anthropoid coffins which had been usurped from a chantress of Amun named *Hatet*. Through examination, it was verified that the *Tayuheret's* anthropoid coffins were made of cedar wood imported from the Levant. This research elucidates the smaller inner anthropoid coffin. Fig (1).

Despondently, the coffin's hands which were originally painted in gold were missing, even both the coffin's face and mummy were believed to have been stolen in the past. Clearly, it was an intentional human mutilation caused during the mummy robbery.

Tayuheret's coffin displays highly elaborate designs. Although the name of *Tayuheret* is written in a simple style, it seems likely that these inscriptions were originally done in the coffin and were not modifications made after they were obtained.

The wig or hair drawn on the wooden coffin is gracefully braided in a way that is unique to high-ranking coffins. A winged goddess (Nut) appears on the central panels of the coffin lids, as well as the coffin slab {5}.

DIMENSIONS:

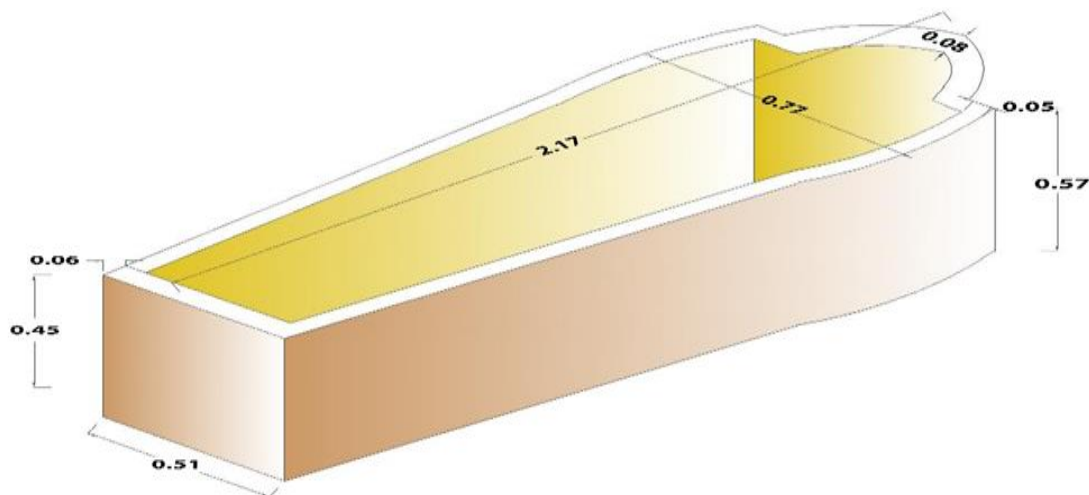


Fig (1)

dimensions of the wooden coffin of Tayuheret.

2- Archaeological description of the coffin

2-1 The first part, the lid,

The ancient Egyptian was interested by the lid of the coffin, as it is, according to the ancient Egyptian thought, it leads the deceased to the sky and is the gate of crossing to Osiris, and this is evident through the scenes that the ancient Egyptian was keen to exist since the appearance of the coffins. The lid; it takes the anthropoid shape and carries the majority of decorations and texts, unfortunately; the head is completely destroyed. Through the study, it was proven beyond

a reasonable doubt that the cover was destroyed by antiquities thieves where the hands carved in the lid of the wooden coffin were stolen, as is evident through examination and study {6}.

2-2 Outstretched Deity

First scene after the broad collar on the lid was the outstretched goddess, the majority of the coffins during LP had represented goddess Nut with outstretched wings, she was the mother of Osiris and played important role helping the deceased in his journey.

A representation of goddess Nut with outstretching wings for protection of the owner of coffin's



Fig (2) the lid of wooden coffin of Tayuheret.

A1: - Remains of the head with tripartite wig and facial features.

A2: -Khyber with outstretching wings.

A3, A4: - Goddess Nut (The register of goddess Nut is so popular on the non-royal coffins during the Late period. The Nut's representation is the guarantee for the deceased to be judged in fair way and helps him to overcome the difficulties in afterlife. Nut always was depicted as full lady with sun disk on her head, holding the feather in each hand referring to her symbol as goddess of justice.

A5: - God and Goddess scenes and some vertical columns of Hieroglyphs inscriptions

A6: - Destroyed feet, the artist was skillful enough in using more colors in this register such as yellow, red, blue on faded creamy background.

2-3 The second part

According to ancient Egyptian beliefs the body container is used to protect the deceased's corpse God *Anubis* and goddess *Isis* and *Nephtys* on the coffin all of whom provided the deceased with power against power of malice in afterlife

The inscriptions of the coffin are written by hands in black ink in an inaccurate manner; there are three vertical columns; they are surrounded by number of ancient Egyptian gods in multi-colored {7}



Fig (3) the front side of the wooden coffin of Tayuheret.

B 1: - On the exterior side, there is a representation of Osiris who appears standing in black color, the scene is surrounding by two protective goddesses *Isis* and *Nephtys* each one is facing each other, Osiris wears the crown.

B2: - It is a representation of Horus 'son ^{3tf} the coffin as follows: God *Imsetis* represented as human being with man head; God *Duamutefis* represented with head of Jackal. God *Happi* is represented with baboon head; finally, God *Qebehsenuf* with falcon head.

B3: - The register of God Amoun Rae and some vertical columns of Hieroglyphs inscriptions, Horussits wearing the crown ^{3tf} in green color; one of his hands holding the sign of life, while the other is holding the sign ^{w3s} In front of the g ^{enb} [♀] while the coffin owner stands behind him.

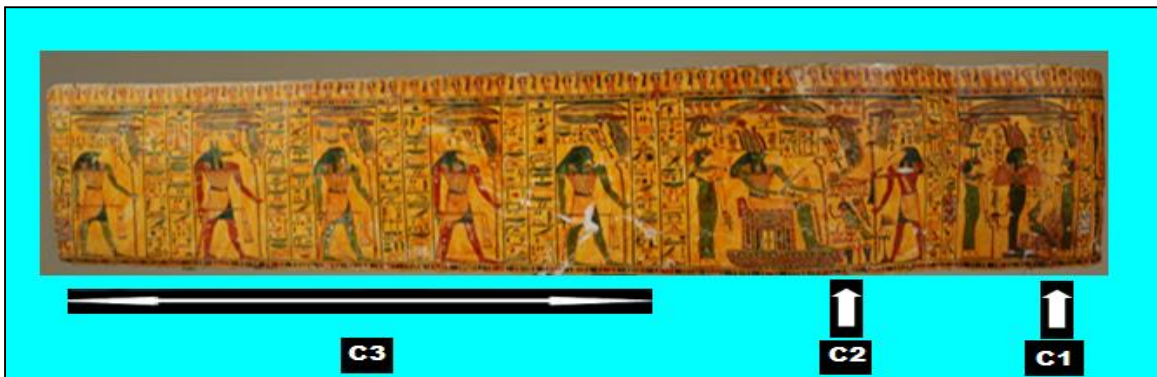


Fig (4) the below side of the wooden coffin of Tayuheret.

C 1: - On the exterior side, there is a representation of Osiris who appears standing in black color wearing the crown, ^{3tf} in the scene Osiris is surrounding by two protective goddesses *Isis* and *Nephtys* each one is facing each other.

C2: - The register of God Amoun Rae and some vertical columns of Hieroglyphs Inscriptions The god sits wearing the ^{w3s} crown of his hands holding the sign of life, while the other is holding the sign

In front of him we find Tehuti stands while the coffin owner stands behind him ^{enb} [♀]

C 3: - There are five Gods vertical columns; they are surrounded by vertical columns in multi-colored {8}.

2-4 Decoration Analysis

- The inscriptions of the coffin are written by hands in black ink in an inaccurate manner; there are vertical columns surrounded by columns of decoration refer to the ancient Egyptian gods, the texts were registered at low lines {9}.

-The inscriptions on this coffin is known as the Hieroglyphs abbreviated; it is considered mediation between the Hieroglyphic and the Hieratic.

It is important to study the coffin of Tayuheret , the coffin isn't only a container used to bury the corps, but also evidence to the materials and techniques used by Egyptians and the development of religious concepts {10}.

3. Materials and Methods

3.1. Samples.

The objective of the conducted scientific examinations and analysis of materials is to identify the nature of the components that enter the composition of the researched materials, to identify factors and indications for archaeological materials, thus construct a scientific method of conservation and preservation. The latter is done by collecting detached samples according to conventional standards and scientific procedures. The sample of wood used for examination had both yellow and red color residues, besides the work done to investigate the preparation layer and the wood itself.

3.2. SEM examination.

The sample was examined in its natural form using JEOL 6400 SEM attached with an EDX unit, as well as the combined system energy dispersive spectrometer. After the samples were coated, a nanometer degree was attached to the SEM holder, they were then positioned into the vacuum chamber to photograph and to get the elemental analysis (EDXS). SEM micrographs were taken with enlargements reaching between 250X up to 3000X.

3.3.X-Ray diffraction (XRD)

The sample was analyzed using X-ray diffraction, analysis performed by PW1840 diffractometer with an X-ray diffractometer using Cu K α radiation (40 kV, 40 mA), a sample holder and proportional detector were rotated. The ICDD data bank of standard X-ray powder spectra were used as phase identification.

3.4. Fournier transforms Infrared spectroscopy (FTIR) analysis.

Binding medium has been studied by Fourier transform infrared spectroscopy (FTIR). The samples were analyzed as KBr pellets by JASCO FTIR 460 plus. This method was used to identify the chromatic mediator of the color components and painted layer. The absorption areas of the sample were compared with standard absorption areas of (Arabic gum - animal glue - egg albumen) {11}.



3.5. Wood identification

Wood identification was carried out by embedding in polyethylene glycol (PEG) a wooden sample and cutting it with a rotative microtome. A slim section measuring 15-20mm was acquired from three principal anatomical directions (transverse, tangential and radial) {12}.

4. Results and Discussion

4.1 Wooden Coffin's identification Study.

By examining the sample of wooden and comparing it with the types of wood used during the ancient Egyptian era, as well as carrying out an anatomical analysis of the sample, it was identified as cedrous lebni wood. It is one of the best types of wood used then due to its resistance against insects and microorganisms, in addition to the suitable firmness of this wood. Thus, it was used in daily life artwork, in funerary furniture and in numerous wooden industries.

The ancient Egyptian word was  was  used for cedar wood, also mentioned in ancient Egyptian texts for the kind of cedar wood {13}

conveyed from the Syrian cities.

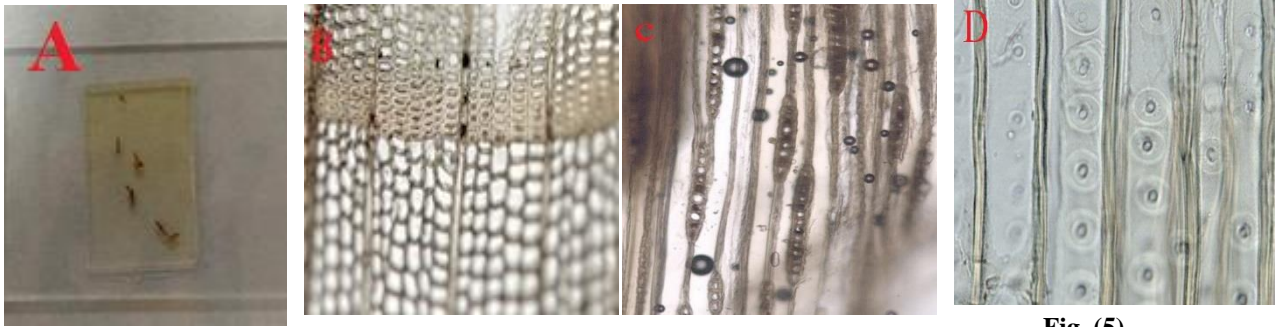


Fig. (5).

Microphotographs of the analyzed Cedrus libani wood sections under the microscope light from lid 2175a.

(A) The first photo is the wooden sample, (B) in the middle transverse section; (C) is tangential longitudinal Section and (D) is Radial section

4.2 Identification of preparation and pigments layers

Tayuhret's coffin contains a layer of polychrome paint, such as yellow, which was used as the base layer below the paint layer, which is the color of the ground, green, blue, red, black, and orange, examined of the preparation layer, and both red and yellow colors were obtainable only as part of the fallen fragments of pigments found when examined using XRD. Table No. (1) Fig (3) XRD analysis revealed that the red color was extracted from iron oxide hematite (Fe₂O₃). As for the yellow color, a rare color extracted from cadmium yellow (CdO). The preparation layer was a major element made of gypsum calcite (CaCO₃) with small amounts of quartz (SiO₂) {14}.

Table (1) shows the compounds of painting layers (red, yellow and preparation layer) that were identified by XRD examination.

Kind of sample	Compounds
Cadmium yellow.	Cadmium Oxide CdO
Iron Red	Hematite Fe ₂ O ₃
layer preparation	Gypsum CaSO ₄ . Quartz SiO ₂

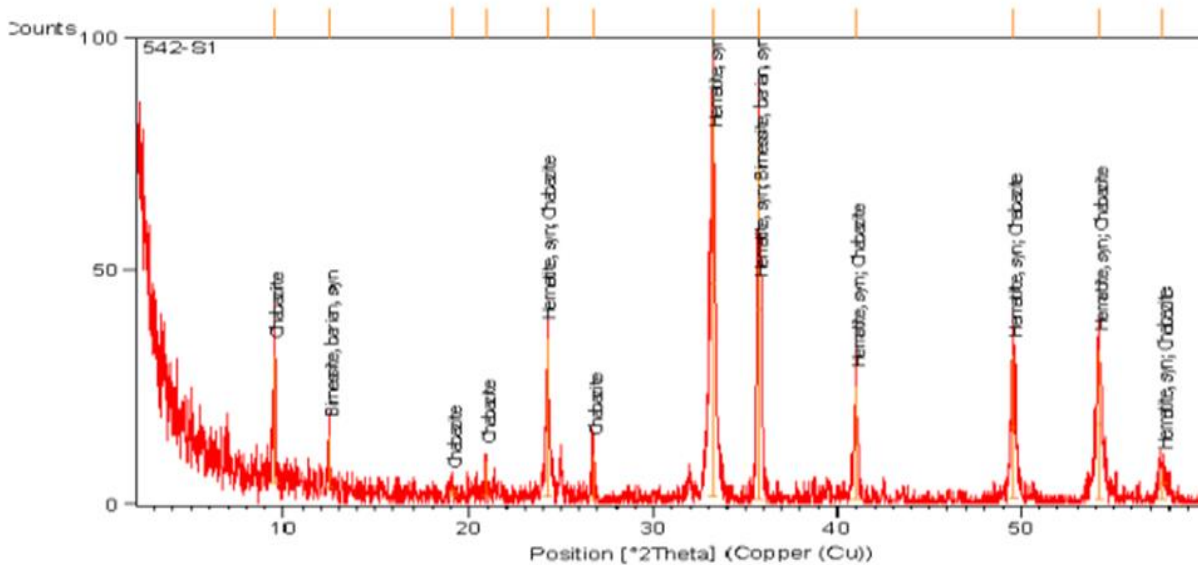


Fig No. (6) shows the X-ray diffraction pattern of the sample of the red colored pigment with the gypsum as preparation layer.

4-3 Fournier transforms infrared spectroscopy (FTIR)

FTIR spectra revealed that the binding medium used for the red color material was determined as animal glue, which was the same material used to bind the particles of the preparation layer by means of gypsum, {15} when comparing the latter with the standard samples of animal glue and with other organic materials that were used. In ancient Egyptian times; egg white or Arabic gum were used for binding {16}. The tested sample results confirmed that it had a high percentage of animal glue within the color layer or the preparation layer. fig. (7). That is, the comparison revealed the functional group of (N-H 1500-1565 cm⁻¹). It was confirmed by the N-H stretching band at 3200-3500 cm⁻¹ and bands corresponding to the stretching frequencies of carbonate (1490-1370cm⁻¹, 910-870 cm⁻¹) {17}.

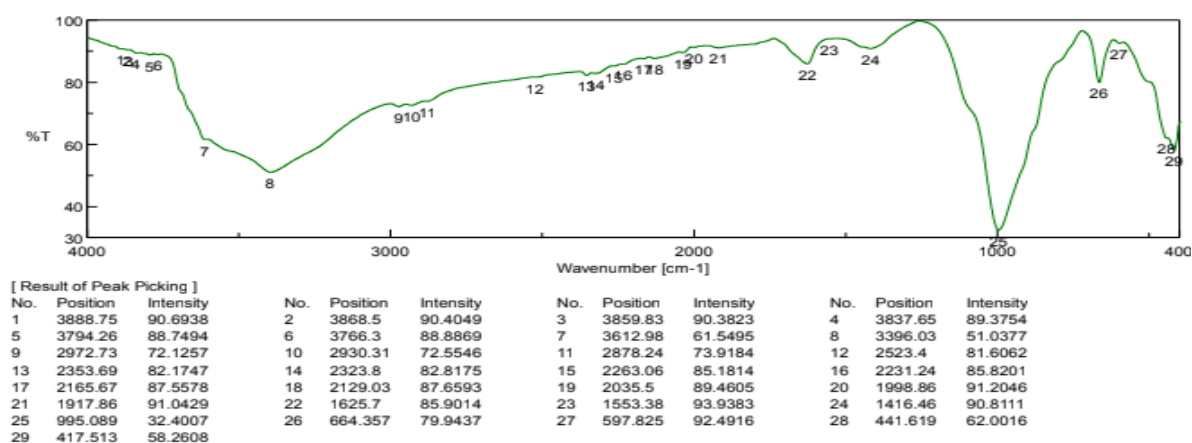


Fig no (7) The graph shows the pattern of the infrared absorption spectrum of the red pigment within the preparation layer. It turned out that the binding used is animal glue.

4-4 Study Electron Microscopy (SEM)

When examining the wood's sample from the coffin of *Tayuhret*, a scanning electron microscope SEM was used, ensuing many indications of deterioration factors on the coffin caused by conservancy at the Egyptian Museum {18}. This led to the deterioration of the fiber texture of the wood and the unintentional deterioration of the cellulose fibers caused by the coffin's exposure prior to the growth of insects and microorganisms. (Fig no.8 A, B, C, and D). During the examination of the overlap between the preparation layer of gypsum and the layer of colors materialized, thus, ironing of the crystals of gypsum salts appeared on the Aloe layer, as shown in (Fig. no. 8 A, B, C, and D). By means of a scanning electron microscope SEM with an EDAX unit, a sample of *Tayuhret's* wooden coffin was found to contain cadmium yellow to acquire the yellow color, this color was not commonly used during the ancient Egyptian era (Fig no. 6) {19}.

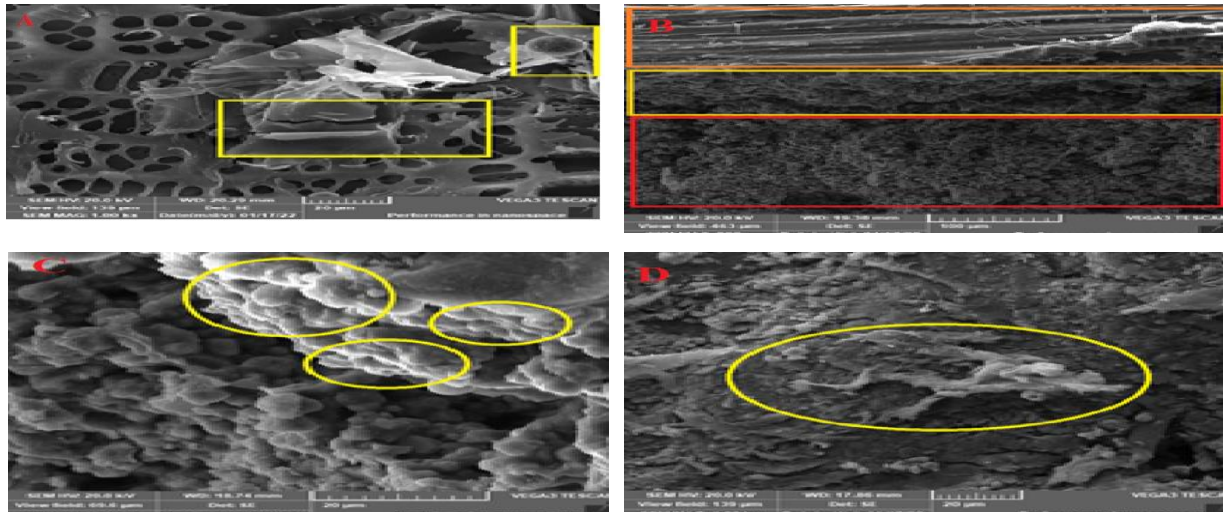
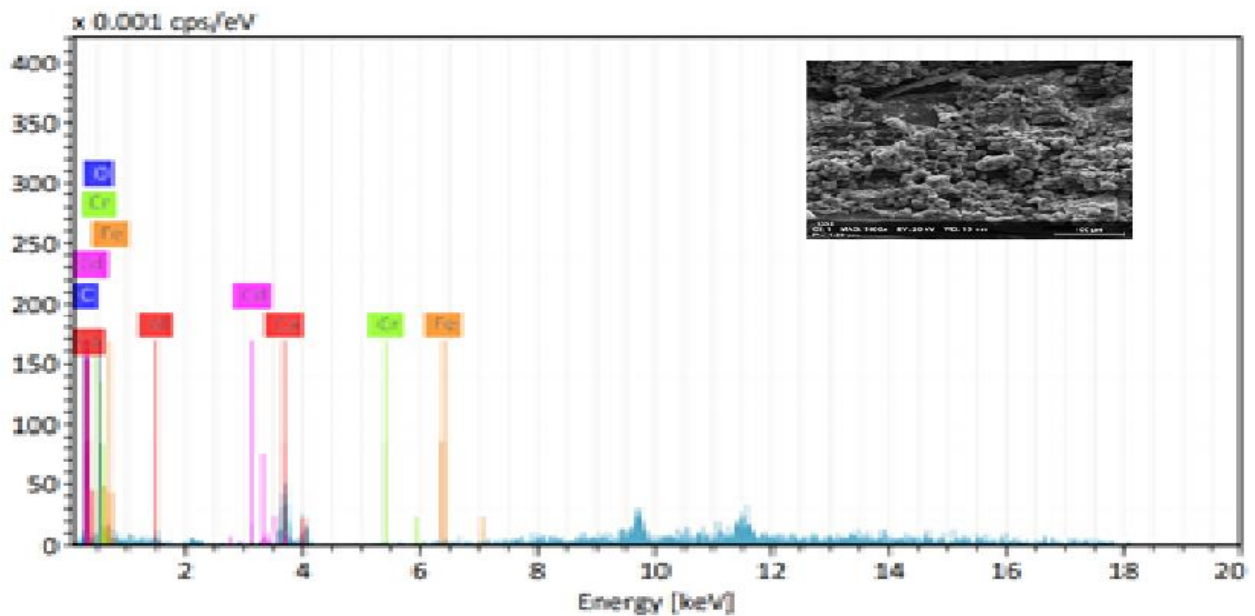


Fig NO (8); (A)-Deterioration of the wooden fiber fabric as a result of insect and microbiological growth on the wooden coffin's fiber. (B)-The layered composition of the coffin of wooden fibers, as well as the layer of the organic binding media and the color layer. (C)- The salty fluorescence on the colored layer. (D)- The salty fluorescence on the color layer.



Element	At. No.	Netto	Mass [%]	Mass Norm. [%]	Atom [%]	abs. error [%] (1 sigma)	rel. error [%] (1 sigma)
Cadmium	48	34	9.13	32.05	6.78	1.70	18.65
Carbon	6	37	7.43	26.09	51.68	5.63	75.82
Calcium	20	271	5.70	20.00	11.88	0.44	7.74
Oxygen	8	10	4.99	17.53	26.07	6.80	136.13
Aluminium	13	15	1.08	3.81	3.36	0.33	30.65
Chromium	24	9	0.10	0.34	0.16	0.06	58.96
Iron	26	4	0.05	0.17	0.07	0.03	54.12
Sum		28.48		100.00	100.00		

(Fig no. 9) Analysis using the EDAX method on a sample with a yellow painting layer, a part of the preparation layer.

5- Conclusion

This research paper reports the case of one of the most important polychrome wooden coffin preserved in the Egyptian Museum in Cairo. It is the wooden coffin of Tayuheret's mummy, which dates back to the third intermediate period.

The ancient Egyptian used cedar wood, which is one of the imported wood that the ancient Egyptian imported from abroad, preferring it to the local wood, which was poorly configured and weak in physical and chemical properties compared to types of imported wood such as this case, which is still characterized by wood fibers in strength and good condition despite the display Museum and storage that is incompatible with the standard international display methods in museums.

The coffin consists of layers of cedar wood covered with a layer of gypsum using animal glue as organic binding media of the components of gypsum, and it is covered with a yellow floor of cadmium oxide which was rare in ancient Egyptian times, in addition to the red color of hematite, as indicated by the results of the examination and analysis that were conducted in this scientific paper.

This polychrome humanoid wooden coffin was executed with great precision, indicating the progress of wooden coffin industry during the Third Intermediate Period and mostly throughout the ancient Egyptian period.

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