CONSERVAR PATRIMÓNIO

Non-invasive wood identification on parts of King Horemheb’s ritual couches (New kingdom)

Identificação não invasiva de espécies de madeira presentes em camas funerárias do túmulo do Rei Horemheb (Império Novo)

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Abstract

The inclusion of couches as basic artefacts of ritual use in ancient Egyptian royal tombs first emerged in the New Kingdom; these are very rare objects, and very little information is available concerning the timber used to make them. To address this knowledge gap the present paper deals with the identification of wood from parts of ancient Egyptian ritual couches from King Horemheb’s tomb using reflected light microscopy as a non-invasive analytic technique. Although these couches are from a royal tomb, our results show that the four identified wood species (Cedar of Lebanon, Sycamore fig, Tamarisk and Christ’s thorn) are among the most common timbers found in ancient Egypt. This confirms that the shortage of timber in ancient Egypt forced the use of the few available timbers for specific purposes, according to their properties, and led the Egyptian carpenters to use large logs from external sources, such as cedar of Lebanon, confirming trading of wood in ancient Egypt.

Keywords

King Horemheb; Ritual couches; Wood identification; Cedar of Lebanon; Christ’s thorn.

Resumo

A inclusão de camas funerárias como artefactos rituais em túmulos reais no Egipto antigo teve o seu início no Império Novo. Tratam-se de objetos de elevada raridade, havendo muito pouca informação relativamente à madeira utilizada para os fabricar. O presente artigo incide sobre a identificação de madeiras pertencentes a peças de camas funerárias egípcias provenientes do túmulo do Rei Horemheb, através de microcopia ótica com luz refletida como técnica analítica não-invasiva. Embora estes objetos

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pertençam a um túmulo real, os resultados obtidos demonstram que as quatro espécies de madeira identificadas (Cedro-do-Líbano, Sicómoro, Tamargueira e Espinho de Cristo) encontram-se entre as mais comuns do Egipto antigo. Estes dados confirmam que a escassez de madeira no Egipto antigo levou a que as poucas espécies de madeira existentes localmente fossem utilizadas para funções específicas, de acordo com as suas propriedades, enquanto para a obtenção de madeira de maior envergadura, os carpinteiros Egípcios tiveram de recorrer a fontes externas, tais como o Cedro-do-Líbano, confirmando a existência de rotas comerciais de madeira no Egipto antigo.

Palavras-chave

Rei Horemheb; camas funerárias; identificação de madeira; *Cedrus Libani*; *Ziziphus spina-christi*.

Introduction

The inclusion of ritual couches as basic artefacts in ancient Egyptian royal tombs first appeared in the new Kingdom; they were supposed to symbolize the transference of the deceased King to celestial regions and the conferring of immortality and deification upon them exerted far-reaching and manifold effects as it was diffused abroad among other peoples [1]. This type of couches present three different shaped mythical animals (Lioness, Hippopotamus and Cow). The basic construction of each couch is similar, consisting of four parts: the couch itself, which has a footboard and an imitation mesh mattress; two supporting animal-shaped side-sections attached to the couch through metal staples, hooks and angle pieces; and a rectangular base, where the feline legs and feet from the animal-shaped side-sections are slotted into [1-2]. They were made of wood, then gessoed and gilded or painted, and sometimes covered with black resin. The couches are very rare and very little information is available concerning the timber used to make them in ancient Egypt. Due to the low availability of wood for sampling and analysing, a large amount of Egyptian wooden artefacts are preserved in museums without scientific identification such as the collection of King Horemheb at the Egyptian Museum in Cairo. In recent papers, reflected light microscopy (RLM) was considered as an effective tool for non-invasive identification of historical wooden objects [3-4]. So, the purpose of this work is to non-invasively identify the botanical species of wood, through the use of reflected light microscopy, to improve our knowledge of wood species used for making ritual couches in King Horemheb period for the first time since the discovery of his tomb in 1908.

Materials and methods

The studied objects

Parts of three animal-shaped wooden couches, which are summarized in Table 1, were discovered inside the tomb of Horemheb (KV57) in the Valley of the Kings by British

Egyptologist Edward Ayrton in 1908. Unfortunately, the complete construction of these funerary items was damaged due to the rubble that filled the tomb, and by floods caused by heavy rains for thousands of years. After the discovery of the tomb, these items were preserved in the Egyptian Museum without scientific identification. In 2018, these items were transported to the Wood Conservation Laboratory of the Grand Egyptian Museum – Conservation Center (GEM.CC) for investigation and conservation.

Optical microscopy

Visible wooden areas of these objects were observed with A Keyence VHX – 900F digital microscope (Japan) equipped with VH-ZST Dual-objective zoom lens, which allows observation at magnifications from 20-to 2000x with changing lenses and light from normal to polarized. All sections were observed rigorously using a VW-S 200 Free angle stand (which facilities the observation of the objects with the camera and lens positioned at any angle), avoiding any kind of surface alteration (Figure 1). Each visible feature was recorded and documented through reflected light using a VHX – 5020 digital camera. Because of the reduced visibility of features entailed in the observation of non-prepared surfaces (i.e. neither oriented nor surfaced), the absence of specific features was not used for identification.

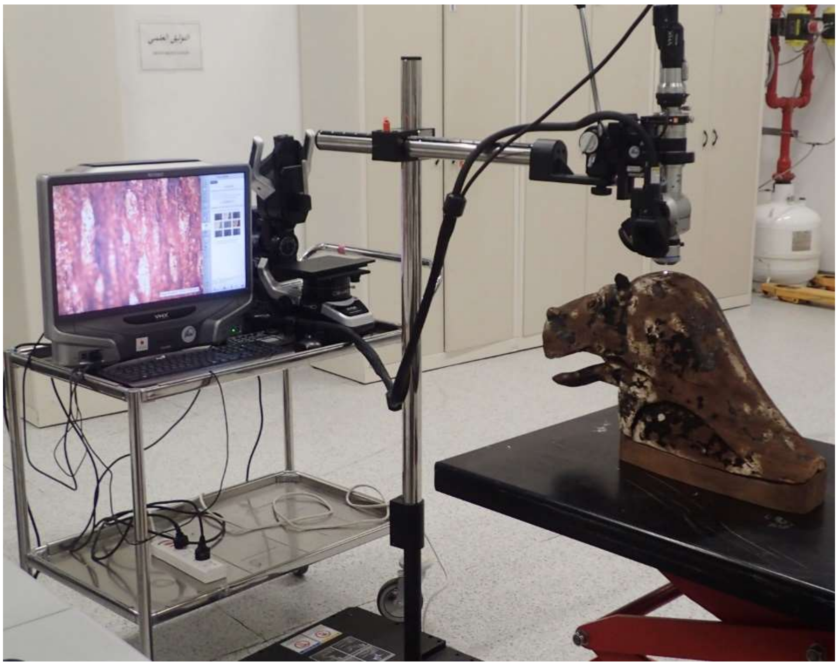

Figure 1. Set up for non-invasive wood identification of Hippo headed couch using A Keyence VHX – 900F digital microscope equipped with VW-S 200 Free angle stand, which enables the observation of the objects with the camera and lens positioned at any angle, avoiding any kind of surface alteration through reflected light.

Species identification

Observation and description of anatomical features for the wood were based on wood anatomy atlases, textbooks and databases [5-10].

Results and discussion

The results of microscopic identification from wood objects are summarized in Table 1. The anatomical features observed through reflected light microscopy used to identify the four wood species are listed in Table 2. Four different species of wood [*Cedrus Libani* (Cedar of Lebanon), *Ficus Sycomorus* (Sycamore fig), *Tamarix sp*. (Tamarisk), *Ziziphus spina-christi* (Christ's thorn)] were identified in different parts of the objects, as shown in Figures 2 and 3.

Table 1. Object number, Piece name, and species identification.

Object No	**Piece name**	**Identification**	
		English name	**Botanical name**
GEM 13936	Hippo-headed couch (Figure 2a)	Sycamore fig Cedar of Lebanon Tamarisk	*Ficus Sycomorus* L. *Cedrus libani* A. Rich *Tamarix* sp.
GEM 13887	Hippo-headed couch (Figure 2b)	Sycamore fig Cedar of Lebanon Tamarisk	*Ficus Sycomorus* L. *Cedrus libani* A. Rich *Tamarix* sp.
GEM 13913	Lioness-headed couch (Figure 2c)	Cedar of Lebanon Tamarisk	*Cedrus libani* A. Rich *Tamarix* sp.
Other 55339	Lioness-headed couch (Figure 2d)	Cedar of Lebanon Tamarisk	*Cedrus libani* A. Rich *Tamarix* sp.
Other 3979	Mouth of cow-headed couch	Sycamore fig	*Ficus Sycomorus* L.
GEM 80017	Legs of cow couch (Figure 3a)	Cedar of Lebanon	*Cedrus libani* A. Rich
Other 4062	Part of animal body couch (Figure 3b)	Cedar of Lebanon	*Cedrus libani* A. Rich
GEM 13878	Bracket (Figure 3c)	Christ's thorn/ sidder	*Ziziphus spina-christ* (L.) Willd.

Table 2. Anatomical characteristics used for wood identification.

Taxa	**Transverse section (TS)**	**Tangential longitudinal section (TLS)**	**Radial longitudinal section (RLS)**
Cedrus libani (Cedar of Lebanon)	Growth rings distinct, transition from early to late wood gradual (Figure 4a). Although not present in this specimen, it should be noted that cedar of Lebanon wood, can sometimes have an arrow of tangentially orientated traumatic resin canals which show up in TS.	Rays exclusively uniseriate. Its height is high to very high (more than 30 cells) (Figure 4b).	Radial tracheids present. End walls of ray parenchyma cells distinctly pitted (white arrows) (Figure 4c). Figure 4d shows scalloped torus margins of bordered pits in the radial walls of tracheids, which are diagnostic of Cedar of Lebanon. Bordered pits with cross fields of taxodioid type were difficult to observe.
Ficus Sycomorus (Sycamore fig)	Growth rings indistinct, diffuse-porous, vessels solitary and in multiples (Figure 5a). Banded axial parenchyma with most bands greater than four seriate; scanty paratracheal or vasicentric axial parenchyma (Figure 5b).	Multiseriate rays of two distinct widths; some rays 4–10 seriate; some rays greater than 10 seriate (Figure 5c), some sheath cells and laticifers present (Figure 5d).	Simple perforation plates and alternate inter-vessel pits (Figure 5e, f)
Tamarix sp. (Tamarisk)	Wood diffuse to semi ring-porous. Vessels arranged in radial bands separated by large rays. Axial parenchyma paratracheal (Figures 6a, b).	Multiseriate rays (6–20 seriate) (Figures 6c, d).	Heterocellular rays (Figure 6e). Perforation plates simple (Figure 6f).
Ziziphus spina-christ (Christ's thorn)	Wood diffuse-porous. Vessels solitary and in radial multiples. Diffuse apotracheal axial parenchyma present and paratracheal axial parenchyma scanty or vasicentric (Figure 7a).	Rays exclusively uniseriate (Figure 7b).	Heterocellular rays with procumbent, square and upright cells mixed throughout the ray. Prismatic crystals in ray cells (Figure 7c).

Figure 2. Images of the analyzed animal heads from King Horemheb's tomb, as numbered in Table 1, and rendering of the wood species present: *a)* Hippo-headed couch GEM No. 13936; *b)* Hippo-headed couch GEM No. 13887; *c)* Lioness-headed couch GEM No. 13913; *d)* Lioness-headed couch other No. 55339.

Cedrus Libani A. Rich (Cedar of Lebanon)

The obtained microphotographs (Figure 4) show the wood used for the main parts, such as the two lionesses headed couch, animal body and legs, which was identified as *Cedrus Libani* (Cedar of Lebanon). In addition, small parts used for the lower jaw of the hippo mouth were also identified as Cedar of Lebanon. The features that were crucially diagnostic in the identification of Cedar of Lebanon – scalloped torus margins on bordered pits in tracheid radial walls (Table 2) – can clearly be seen in Figure 4d. The wood from Cedar of Lebanon had been imported into Egypt from very early ages and had a very high reputation as a precious raw material due to its excellent technological characteristics (straight-grained, aromatic, very durable, and taking a good polish), and cedar was the tallest tree in the eastern part of Mediterranean Sea [11-12]. Such properties made cedar wood a favoured choice in ancient Egypt for making high-status coffins and funerary artefacts as well as ships and timber structures [12-17]. So, the presence of cedar in the main parts of the royal couches of King Horemheb is somewhat expected. However, why use such a precious wood for small parts as lower jaw of hippo mouth? Giachi et al. [11], stated that the use of cedarwood for main parts produced wastes as small fragments that could be recycled for the production of small parts or objects such as the lower jaw of hippo mouth in this study.

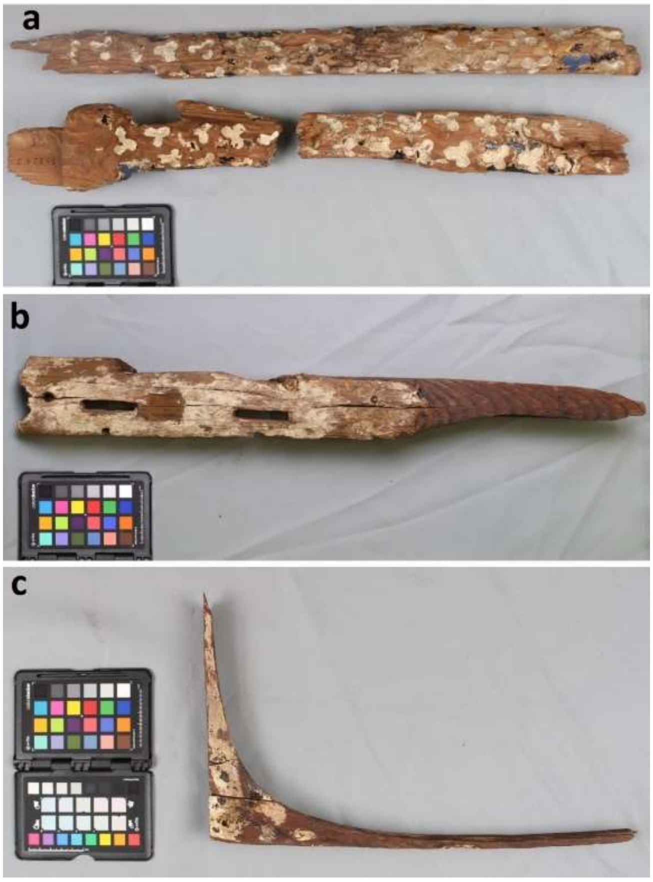

Figure 3. Images of the cow couch parts of King Horemheb as numbered in Table 1: *a)* leg parts GEM No. 80017; *b)* animal body part (Other NO. 4062); *c)* bracket GEM No. 13878.

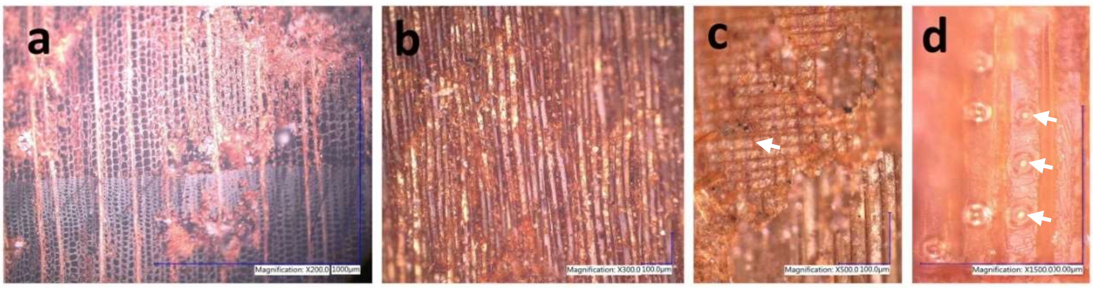

Figure 4. Microphotographs of wood sections under the microscope in reflected light showing the anatomical characteristics of *Cedrus libani*: *a)* TS; *b)* TLS; *c)* RLS; *d)* Details of RLS showing scalloped torus margins of bordered pits (white arrows) in radial walls of tracheids, which are diagnostic of Cedar of Lebanon.

Ficus sycomorus L. (Sycamore fig)

The obtained microphotographs (Figure 5) show the wood used for the hippo and cow heads, which was identified as *Ficus sycomorus (*sycamore fig). The features that were crucially diagnostic in the identification of sycamore fig are banded axial parenchyma with most bands greater than four seriate (Figure 5a, b) and some sheath cells and laticifers present in rays (Figure 5d). Sycamore fig is native to Egypt and one of the relatively few local trees that grow tall enough to yield the long lengths of timber suitable for coffin construction and other artefacts. It also had considerable religious significance, since this tree, and its fruits, in particular, were associated with the goddess Nut. Although much used in ancient Egypt, sycamore fig wood is light, not of high quality and is prone to insect attack [18-21]. In this case, the use of the black resin that covered the wood surface of the couches may have reduced these drawbacks. So, the presence of sycamore fig in royal couches of King Horemheb is somewhat expected and agree with the published data on the black resin shrines from King Tutankhamun collection which showed the use of sycamore with Cedarwood for the main parts [22].

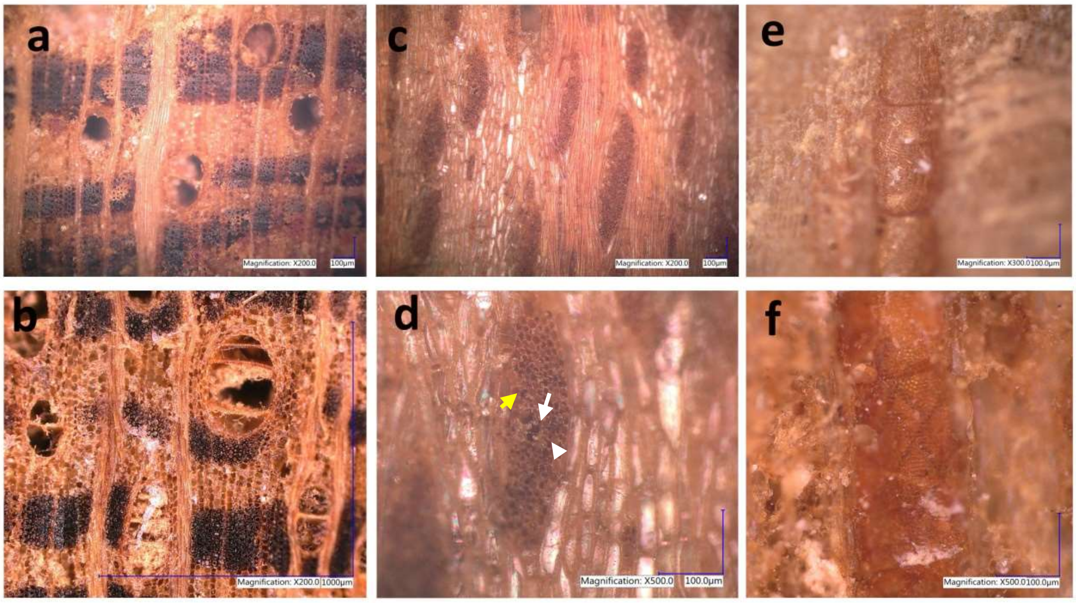

Figure 5. Microphotographs of wood sections under the microscope in reflected light showing the anatomical characteristics of *Ficus sycomorus*: *a, b)* TS showing its characteristic structure of wide-banded fibres; *c)* TLS; *d)* Details of TLS showing sheath cells (yellow arrows) and laticifers (white arrows); *e, f)* RLS.

Tamarix sp. (Tamarisk)

Figure 6 shows that the wood used for the ears of the animals is *Tamarix* sp. (tamarisk). The species of tamarisk present in Egypt, the Sahara and adjacent regions are virtually impossible to separate reliably based on their wood anatomy. The properties of tamarisk woods include medium bending and compression strength, moderate hardness and a coarse and fibrous texture [23]. Moreover, *Tamarix* sp. woods are unlikely to have been available for use as large planks. However, they are ideal where short lengths of timber are required [18, 22]. Such properties made tamarisk woods a favoured choice in ancient Egypt for making small parts, objects, dowels and tenon over a wide chronological period [12]. The obtained result agrees with the previous literature and the published data on the black resin shrines and gilded wooden bed from King Tutankhamun's collection, which showed the use of tamarisk for the small parts [22, 24].

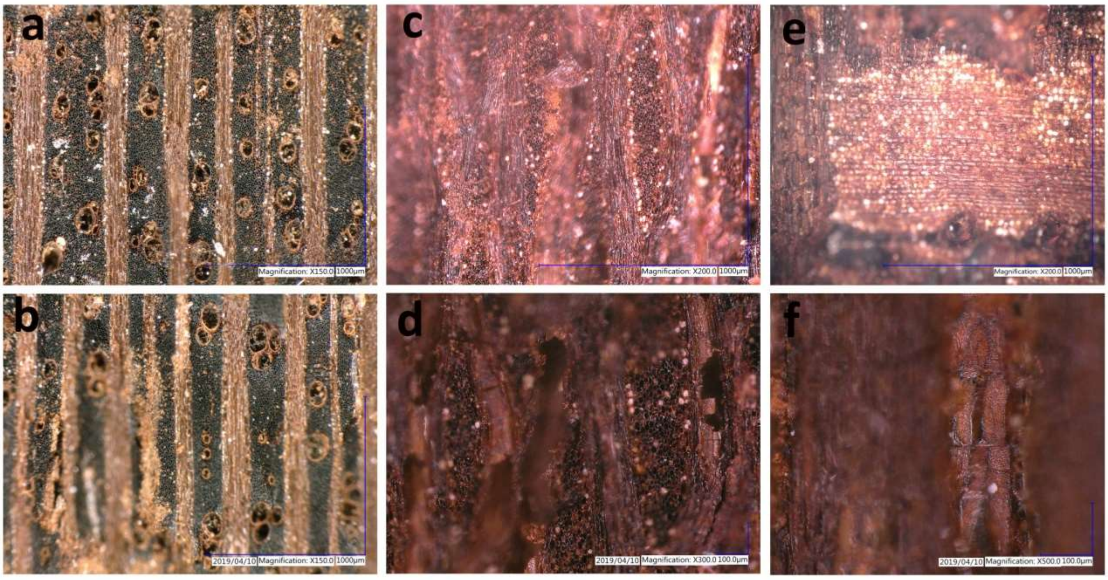

Figure 6. Microphotographs of wood sections under the microscope in reflected light showing the anatomical characteristics of *Tamarix sp.*: *a, b)* TS; *c, d)* TLS); *e, f)* RLS.

Ziziphus spina-christi (L.) Willd. (Christ’s thorn/ sidder)

*Ziziphus spina-christi (*Christ’s thorn) is also native to Egypt [25]. This tree is not large enough to provide the boards that formed the main parts of the large artefacts, but its wood is hard and durable and is highly suitable for tool handles, furniture components, tenons and pegs [12, 18, 22]. The obtained microphotographs showed that Christ’s thorn (Figure 7) was used for making brackets, confirming the previous texts which showed that carpenters in ancient Egypt tended to make use of off-cuts of high-quality wood, such as cedar of Lebanon, and also often specifically chose woods that were not of the same species as that used for the main part of the artefact. This works well when the different properties of the various species selected respond in a way that creates a tight fit, locking the components together. It also enables hard dense woods such as *Acacia spp.* (acacia) and *Ziziphus spina-christi* (Christ’s thorn), which are normally only available as short lengths of timber, to be used to their maximum effectiveness [17, 19].

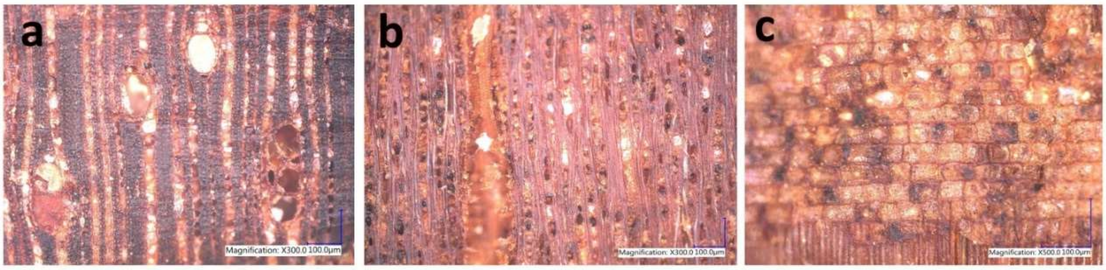

Figure 7. Microphotographs of wood sections under the microscope in reflected light showing the anatomical characteristics of *Ziziphus spina-christ* (L.) Willd.: *a)* TS; *b)* TLS; *c)* RLS.

Conclusion

In this study, the identification of wood species for an ancient Egyptian couches parts of King Horemheb using a non-invasive technique through the reflected light microscopy was successfully conducted. In several examined cases accurate wood identification was possible and the use of polarized light improved the visibility of characteristic features. Shape and orientation of surfaces influenced the visibility of microscopic characters in few cases; however, it can anyway provide important information, useful to help decide about supposed species, or to limit the invasiveness of possible further analyses by addressing them on specific features. The results showed that the wood used on the couches is not limited to one species, but instead, four kinds of wood [*Cedrus Libani* (Cedar of Lebanon), *Ficus Sycomorus* (Sycamore fig), *Tamarix* sp. (Tamarisk), *Ziziphus spina-christi* (Christ's thorn/ Sidder)] were identified on different parts of the couches. These results reveal that the Egyptian funerary carpenters not only used whatever wood was most readily available or common locally, irrespective of its particular properties, but also selected specific woods primarily because their properties matched carpentry and design requirements. The results of this research represent a first step in determining the wood species used to produce this particular kind of couches during King Horemheb's period.

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