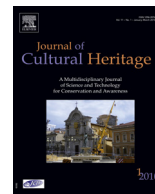




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## Case study

# Characterization of the organic materials used in the painting of the vaulted ceiling at the Saadian Tomb of Mulay Ahmed Al-Mansour (Marrakech)

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## ARTICLE INFO

### Article history:

Received 20 January 2012

Accepted 17 May 2013

Available online 21 June 2013

### Keywords:

GC/MS

Saadian Tombs

Gilding mordant

Pine resin

Natural Gum

Restoration treatment

## ABSTRACT

The Saadian tombs from the era of sultan Ahmed al-Mansour (1574–1603) are beautifully decorated and have always been a major attraction for visitors to Marrakesh. The central mausoleum, named the Hall of Twelve Columns, encloses the tombs of Ahmed al-Mansour and his family. The hall has a huge vaulted ceiling, carved cedar doors, opening windows with wooden marquetry screen (Mashrabiya), and grey Italian marble columns. This paper presents the first attempt to identify the organic materials used by the Moroccan artisans. A GC/MS analytical procedure was used for the characterization of lipids, waxes, resins, pitch, tar, proteinaceous and saccharide materials in the same paint micro-sample. The analytical study identified the organic materials used in the polychrome and gilded decorations of the walls, ceiling and dome of the hall. Data showed that the polychrome decorations were painted using animal glue as a binder, and highlighted the treatment of the wall surface with linseed oil and the retouching of the paintings based on a saccharide binder. The use of a proteinaceous-resinous-oil mixture, applied on a proteinaceous preparation layer, for the gilded decorations revealed a very similar technique to that used at the time in Europe for mural paintings.

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## 1. Research aims

The Saadian tombs in Marrakesh (1574–1603) are beautifully decorated with polychrome, gilded stuccos and decorative ornaments made from cedar wood. The loss of brightness and cohesion of the paintings has meant that the tomb has had to undergo a restoration campaign. An analytical investigation was thus undertaken in order to identify the organic materials present in the decoration, both as binders or restoration materials from previous campaigns. The painting technique of the Saadian tombs has never been studied even though their historic-artistic importance is of special relevance not only in terms of their value but also because of the lack of information regarding Hispano-Muslim painting techniques. Although some studies have been published on the painting materials used in the polychrome decorations of the Alhambra [1,2] and other buildings in Granada [3,4], and Cordoba [5], results have mainly related to the inorganic composition of pigments and preparation layers, while the organic materials were only identified in a few cases [2–4].

The aim of this study is to provide the first evidence regarding the organic materials used not only by the Saadian dynasty painters but also by the Moroccan artisans in general and to link this information to the Hispano-Muslim tradition.

## 2. Experimental

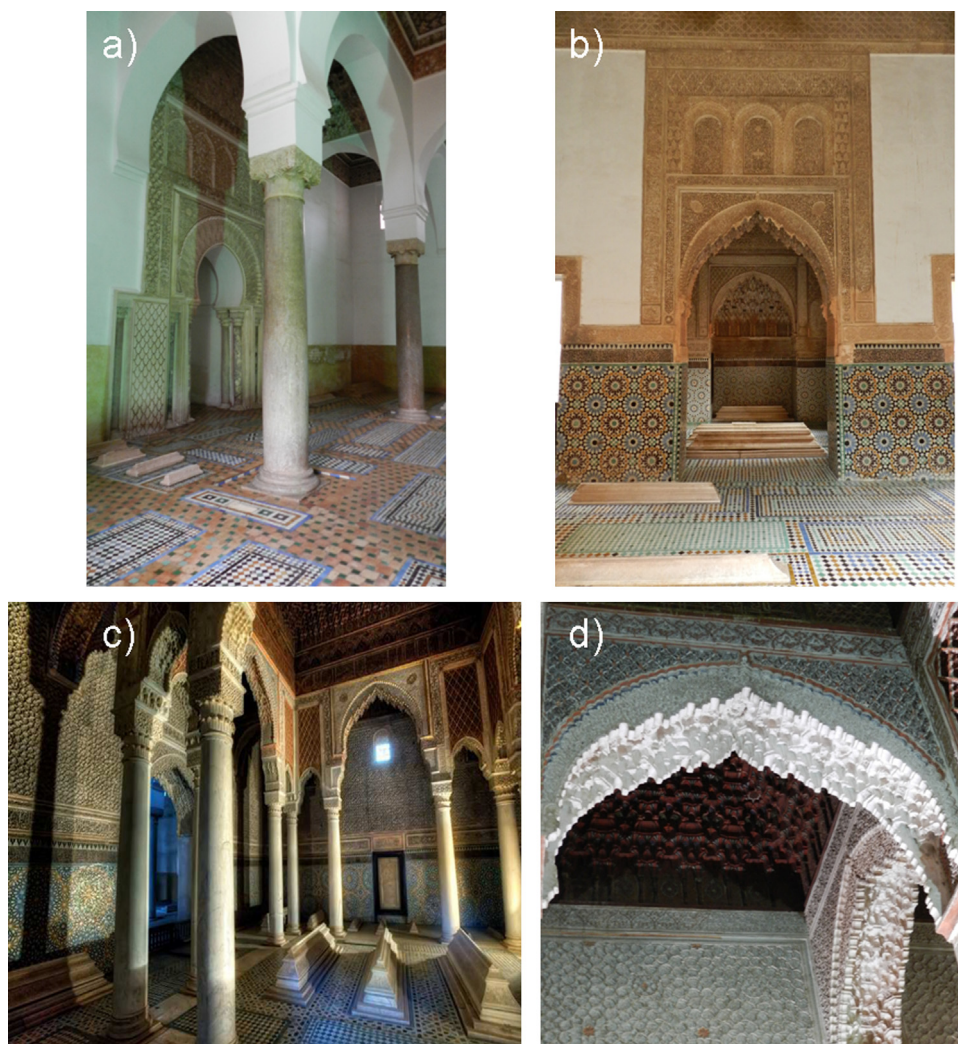
### 2.1. Introduction

The Saadian Tombs are part of a royal necropolis built by the Sultan Ahmed El Mansur el Dahbi (1549–1603). Sultan Ahmed el Mansur conquered Sudan in 1578 after beating the Portuguese army in the battle named the “battle of three kings” [6]. The necropolis is within the walls of the El Mansour mosque, at the northern entrance of the Kasbah of Marrakesh, the capital city of the Saadian dynasty (1554–1659). The Saadian tombs are one of the few remaining vestiges of the Saadian dynasty. The tombs were discovered and restored in 1917, and have been open to the public as an historical site since then. Due to their rich and beautiful decoration, the tombs are a major attraction for visitors to Marrakech.

From an artistic point of view, the stucco ornaments and ceramics, cedar ceilings and the elaborate carvings found in this cemetery are similar to ones in other buildings of the same epoch such as

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**Fig. 1.** Details of the beautiful decorations of the rooms of the Saadian Tombs: a) room 1; b) room 3; c) room 2; d) the dome that was selected for sampling.

the Ben Youssef Madrasa (Marrakech), one of the largest theological colleges in Morocco. These decorations seem to be also linked with the Hispano-Maghreb decorations at the Alhambra (Granada, Spain) [7–9].

However, to our knowledge no technical studies have ever been performed on the cultural heritage of painted works of art in Morocco. Moreover, studies on Hispano-Muslim polychrome decorations are scarce and have mainly focused on the identification of the pigments and plasters, paying almost no attention to the organic materials present in the paint layers [1–5].

The necropolis consists in an open-air cemetery with more than 100 tombs, two buildings that cluster around a courtyard, and a garden, flanked on the east and south by an inner wall with towers. The buildings host approximately seventy graves of family members of Sultan Ahmed El Mansur and their successors [10]. Some details of the decorations of the building rooms are shown in Fig. 1.

The first room (Fig. 1a) is decorated with polychrome stuccos and ornaments made of cedar wood [11], while the third room, called “the three niches”, has marble columns and a dome with painted stalactites. The dome is covered with a series of cedar wood ceilings, which are also painted and gilded. This room contains the women’s and concubine’s tombs (Fig. 1b).

The second room or central hall (The Hall of the Twelve Columns) contains the graves of the Sultan Moulay Ahmed El Mansour, his son and grandson and features a richly decorated dome

resting on 12 columns made of Carrara marble. The headstones, barely protruding from the tiled floor (Fig. 1c), are surrounded by white marble mouldings. The walls are covered with two meters of glazed tiles and an upper layer of elaborated carvings on plaster, showing inscriptions and geometric patterns. At the top of the walls, in contact with the ceilings, there is a framework made of wooden carvings. The cedar wood ceilings are painted and gilded. The lobed stalactite arches are made of red painted cedar wood (Fig. 1d).

Although the wooden ceilings have been subjected to ordinary cleaning maintenance in order to remove the dust, and the polychromes have been retouched and varnished, the site has never undergone a proper restoration and the painting technique of these beautiful decorations has not been investigated to date. The serious problems of detachment of the paint layers mean that an appropriate restoration plan needs to be defined.

This paper presents a GC/MS analytical study to investigate the painting technique and surface treatments used in the polychrome and gilded decorations at the Saadian tombs. Separation techniques have already been proved to be very suitable for the characterization of binding media such as complex mixtures of different organic materials [12–14].

A GC/MS analytical procedure was thus applied for the characterization of lipids, waxes, resins, pitch, tar, proteinaceous and saccharide material in the same paint micro-sample [15]. The Hall

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