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THE CHILDREN OF THE MEDICI, GRAND DUKES OF FLORENCE: EMBALMING IN RENAISSANCE ITALY (XVI-XVII CENTURY)

Abstract - The exploration of the unknown crypt of Gian Gastone de' Medici, the last Grand Duke (1671-1737), under the floor of the Medici Chapels in San Lorenzo (Florence), brought to light the remains of several unidentified children of the family. In particular, the skeletons of a 5-year-old child, probably a male, and of a newborn, showing evidence of autopsy and artificial mummification, were discovered and examined. Comparison of the anthropological data and the information provided by archival and documentary sources allowed us to suggest an identification with infant members of the family. In the thoraco-abdominal cast of the 5 year-old child and in the endocranial and endothoracic cast of the newborn we observed the presence of filling material of vegetable origin which was sampled and submitted to palynological analyses. The results of this study are presented here and compared with contemporary medical literature, which describes the embalming method practised during the Renaissance Age and the vegetable material used to preserve bodies.

Key words - Plants, pollen, mummies, embalming, Medici, Florence, Renaissance

Riassunto - *I bambini della famiglia Medici di Firenze: metodi di imbalsamazione nel Rinascimento italiano (XVI-XVII secolo)*. L'esplorazione della cripta di Gian Gastone de' Medici, ultimo Granduca (1671-1737), scoperta nell'ambito del Progetto Medici sotto il pavimento delle Cappelle Medicee in San Lorenzo a Firenze, ha permesso di indagare le sepolture di alcuni membri infantili della famiglia. In particolare sono stati indagati i resti scheletrici di un bambino di circa 5 anni, di probabile sesso maschile, e di un neonato. Un confronto tra i dati antropologici e le informazioni fornite dai documenti d'archivio concernenti i membri della famiglia Medici deceduti in tenera età ha permesso di proporre un'identificazione dei due bambini. All'interno del calco toraco-addominale del bambino di 5 anni e del riempimento endocranico ed endotoracico del neonato è stato rinvenuto materiale di riempimento di origine vegetale e i campioni prelevati sono stati sottoposti ad analisi palinologiche. I risultati di questo studio vengono discussi e comparati con le informazioni fornite dalla letteratura medica contemporanea, che descrive i metodi di imbalsamazione in uso durante il Rinascimento e le piante usate per la conservazione dei corpi.

Parole chiave - Piante, polline, mummie, imbalsamazione, Medici, Firenze, Rinascimento

Introduction

The Medici represent one of the most powerful and influential families of the Italian Renaissance. As a result of their successful commercial and banking activities, they built long-lasting social power and political prominence, initially in Florence, and later in the entire Tuscany region.
In 2004 the «Medici Project», a multidisciplinary research for the study of the 49 burials of the Medici in San Lorenzo, was officially launched, involving research groups of the University of Pisa, the University of Florence and the Superintendence for Florentine Museums. Up until now 20 tombs, including the burials of nine children, have been investigated (Fornaciari *et al.*, 2006; 2007).
The bodies of the Medici were treated before burial, as imposed by the political and economical prominence of these personages, and also attested by the written sources (Pieraccini, 1986). However, most of these burials had already been explored in the second half of the XX century (Sommi Picenardi, 1888) and again during the Second World War (Genna, 1948). All traces of soft tissues have disappeared; in fact the bodies are currently skeletonized, although they were originally almost all artificial mummies. Nevertheless, 11 out of 20 individuals showed signs of autopsy and/or embalming (Fornaciari *et al.*, 2008); the damage of infantile bodies during the flooding of Florence in 1966 prevented the observation of further signs of embalming in many children of the family.

Materials and methods

Examination of the intact tomb of Gian Gastone, the last Medici Grand Duke (1671-1737), located under the floor of the Medici Chapels in an unknown hidden crypt, brought to light, besides the large sarcophagus of Gian Gastone, also many small wooden coffins, belonging to unidentified children of the Medici family. Although the coffins were collapsed to the floor and covered by a layer of dry mould, residual of the

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disastrous flood of 1966, some of the children burials were considerably well-preserved.
In particular, the remains of a child anthropologically aged around 5 years (MED40.2), and of probable male sex (Fornaciari *et al.*, 2008), and of a newborn of undetermined sex (MED40.34), were in good state of preservation and showed evidence of artificial mummification; the filling material used in embalming was still present in the body cavities.
The problem consisted in the absence of elements, either outside or inside the tomb, that could help identify the children. As generally occurs in these cases, the anthropological data were compared with the information provided by archival and documentary sources referring on some of the children of the family who died in infantile age, in order to identify the skeletal remains found in the Gian Gastone crypt (Pieraccini, 1986).
The filling material was observed in the thoraco-abdominal cast of the 5 year-old child and in the endocranial cast and mould of the newborn's thorax. The filling consisted of earthy and pulverised material of vegetal origin; no macroremains were found. Several samples were taken from the bodies of both children and were submitted to specialist palynological analysis. All the samples were stored in rigid, hermetically closed containers, a condition which allowed preservation with no content alteration. Samples thus predisposed were transferred to the Palynology Laboratory - Archaeoenvironmental Laboratory of C.A.A. Giorgio Nicoli (San Giovanni in Persiceto, Bologna, Italy). Analyses were carried out applying a methodology already tested for recent pollen substrates, with some minor modifications (see Giuffra *et al.*, 2011). Observation of the samples was performed at 1000 light microscope magnification (ocular 10× and objective 100×). Determination of the grains/granules was based on the Palinoteca of our Laboratory, on the current Atlases and the pollen keys, as well as on a vaste amount of specific miscellaneous morphopalinological bibliography. The pollen terminology is based on Berglund and Ralska-Jasiewiczowa (1986) with slight modifications that tend to simplify nomenclature of plants; the denomination of pollen taxa is in keeping with that of the Author of the relative keys. The botanic terminology follows that of Pignatti (1982) and Zangheri (1976) with slight modifications.

Results

The 5-year-old child mummy

This child can be identified with Don Filippo (1598-1602), sixth son of Ferdinand I (1549-1609), 4th Grand Duke of Tuscany, and Christina from Lorraine (1565-1636), who died when he was 4 years old. In fact, the other child of the Medici family who died at the same age was Don Filippino (1577-1582), son of Francesco I (1541-1587), 2nd Grand Duke of Tuscany, and Giovanna from Austria (1548-1578). However, with regard to the latter case, the documentary sources refer that, after death, the head of the Prince was dissected to perform an autopsy and that he was buried with a red velvet dress that reached up to the feet (Pieraccini 1986, pp. 260-261). The remains of a 5-year-old child, showing evidence of craniotomy and wearing a red silk jacket, were found in Gian Gastone's crypt. Therefore, the child in the red jacket is clearly Don Filippino, son of Francesco I, while the infant of this study that shows no signs of craniotomy, is to be identified with Don Filippo, son of Ferdinand and Christine.
Because he died so young, very little is known about this child. The first attestation of the disease fatal to Filippo dates back to April 1st, 1602. He experienced some fever accompanied by severe respiratory complications and abdominal swelling in the Belvedere villa of Florence. The documents attest that on the same day of death, April 3rd, the physicians Pier Rossi, Fonseca and Turini autopsied the little corpse, opening the thoracic and abdominal cavities and examining the internal organs. Filippo was then buried in San Lorenzo (Pieraccini 1986, pp. 364-365).
The cast of the thoraco-abdominal cavities was preserved among the remains of the 5-year-old child. The mould of the lungs (Fig. 1, black arrows) and of the mediastinum (Fig. 1, grey arrow), as well as the nega-

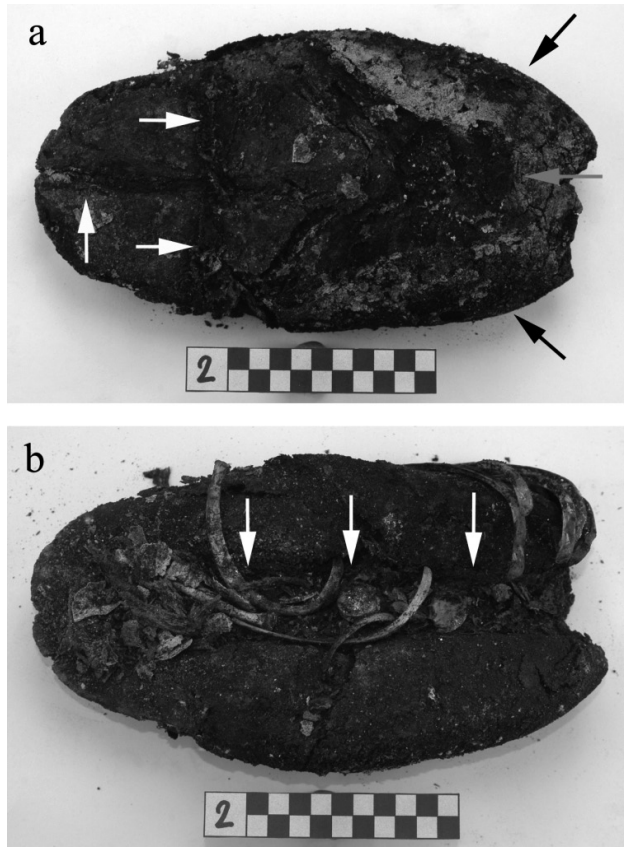

Fig. 1 - The cast of the thoraco-abdominal cavities of a 5-year-old child with: (a) mould of the lungs (1a, black arrows) and the mediastinum (1a, grey arrow). The negative mould of the vertebral column in the back can be recognised easily (1b, white arrows). Evisceration is confirmed by the well-visible xyphopubic and umbilical-transverse incisions (1a, white arrows).

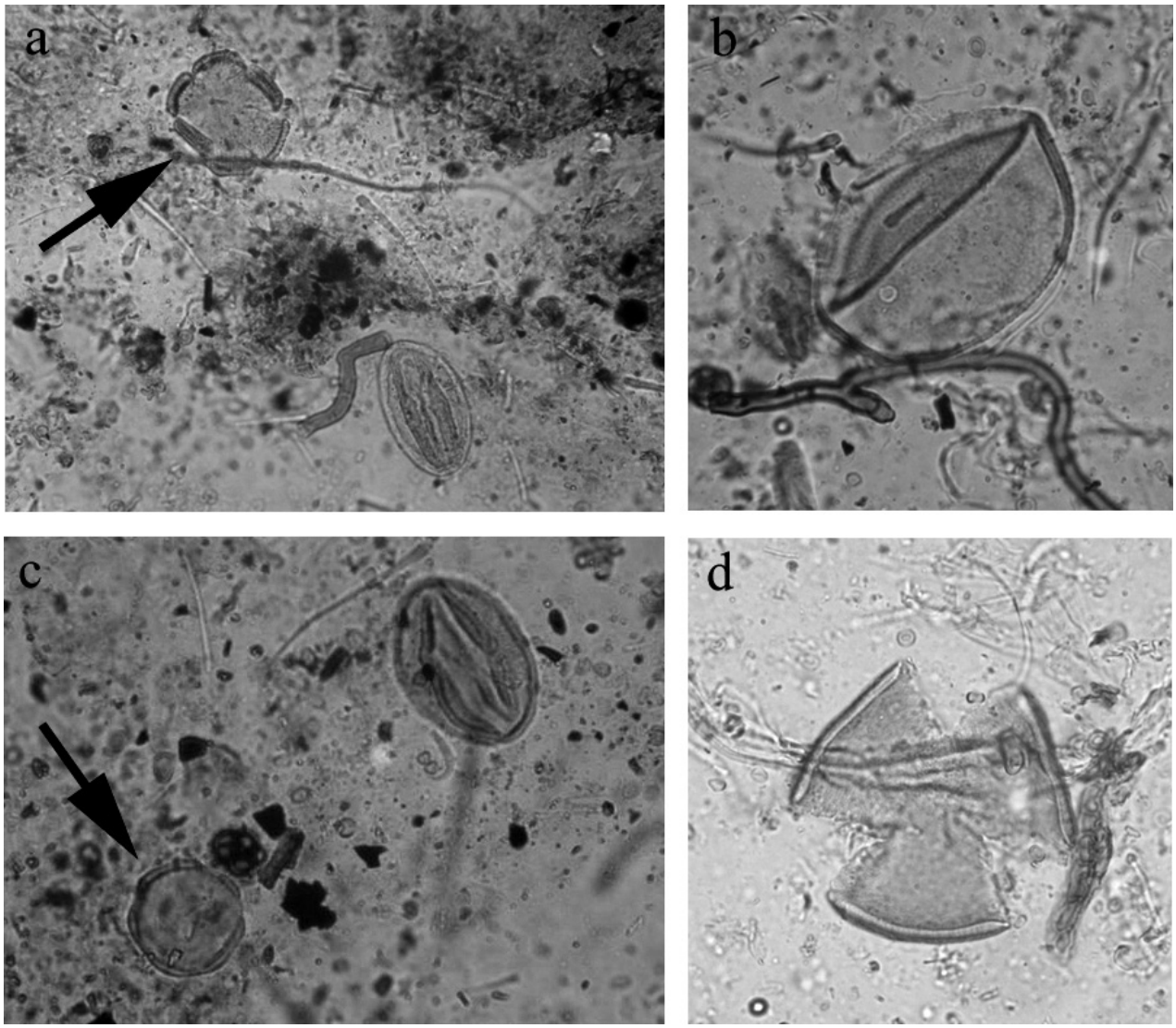

Fig. 2 - Pollen grains at light microscope found in samples of the 5 year-old child: (a) oaks/*Quercus* deciduous (31 μ) and mint/*Mentha* (29 μ) (black arrows); (b) wheat/*Triticum* (50 μ); (c) rockrose/*Cistus* (34 μ) and mint/*Mentha* (27 μ) (black arrows); (d) dead nettle/*Lamium* (34 μ).

tive mould of the vertebral column in the back, could be recognised easily (Fig. 2, white arrows). Evisceration is confirmed by the well-visible xiphopubic and umbilical-transverse incisions (Fig. 1, white arrows).
In this mummy samples were taken from the thoraco-abdominal cast; in total, 502 pollen grains, belonging to 26 taxa, 5 of which referable to woody plants and 21 to herbaceous species, were counted. Pollen grains of decidous oaks/*Quercus* deciduous (35.5%) (Fig. 2a), rockrose/*Cistus* (15.6%) (Fig. 2c), poppy/*Papaver* (2.1%), hemp/*Cannabis sativa* (2.1%), wheat/*Triticum* (1.4%), rue/*Ruta* (1.4%) and various Labiatae, like germander/*Teucrium (*8.5%) (fig.2b), *Phlomis* (8.5%), sage/*Salvia* (4.3%), *Melittis* (2.1%), mint/*Mentha* (0.7%) (Fig. 2a and 2c), and dead nettle (*Lamium*) (0.7%) (Fig. 2d), were found.

The newborn mummy

Two possible identifications with infant members of the Medici family are possible for the newborn, who could be identified with Romola (November 20 1568 - December 2 1568), second daughter of Francesco I and Giovanna from Austria; information about this child is scarce and the documentary sources only report that she survived for a few days before dying and that she was buried in San Lorenzo (Pieraccini, 1986, p. 254). The other child with which the discovered remains could be identified is an unnamed daughter of Ferdinando II (1610-1670), 5th Grand Duke of Tuscany, and Vittoria della Rovere (1622-1694). We know that she died on the same day of her birth, May 31, 1641.
A third identification with Don Antonio (July 1st 1548? – 1548?), son of Cosimo I (1519-1574), 1st Grand Duke of

Tuscany, and Eleonora from Toledo (1522-1562) is more unlikely. This child was the third son of Cosimo, but his name is reported only once in the written sources, and no other information is known (Pieraccini, 1986). From this silence we can infer that death must have arrived early, probably within the first year of age, otherwise some traces would have been left in the family documents.
Evident signs of autopsy and embalming were revealed by thin incisions of the external skull, horizontal and oblique craniotomies, longitudinal and transversal cuts of the sternum, and sectioning of the sternal extremities of the ribs (Fig. 3).
In total, 504 pollen grains, belonging to 11 taxa, 3 of which referable to woody plants and 8 to herbaceous species, were counted. In the endocranial cast of this child pollen grains of germander/*Teucrium* (80.8%) (Fig. 4a) with some pollen grains referable to wall germander/*Teucrium chamaedrys*, chamomille/*Matricaria chamomilla* (6.8%) (Fig. 4c), olive/*Olea europaea* (4.0%) (Fig .4b), grapevine/*Vitis vinifera* (0.6%) (Fig. 4d) and pine/*Pinus* (0.6%) were found.

Discussion

Particularly interesting is the comparison between the results obtained from palynological analyses and contemporary texts, which report embalming methods, as well as instructions and recipes concerning plants and vegetable materials employed for treatment of the bodies (Marinozzi & Fornaciari, 2005).
Abroise Paré (1509-1590) is the author of a surgical work that had a large diffusion in France and in Europe and that conferred the dignity of a real surgical discipline to the art of embalming. A chapter of this text is titled *De la façon d'embaumer les corps morts* (1652) and represents one of the most important works for the reconstruction of the embalming methods of the 16th century. According to the method referred by Paré all internal organs were removed, including the brain, the whole body was accurately washed with a sponge soaked in brandy and strong vinegar, and all the openings and incisions were filled with pulverized aromatic substances. Aromatic oils were sprinkled over the entire body.
The subsequent French authors drew substantially from Paré's method, applied to evisceration, craniotomy, washing of the internal cavities and filling with different balms and aromatic substances. In particular, Jacques Guillemeau (1544-1613), disciple of Paré and surgeon of Carl IX, Henry III and Henry IV, kings of France, describes the embalming methods in the last chapter of his surgical work entitled *La vraye et perfaicte methode de conserver et embaumer les Corps morts. Avec la description des Baumes qui sont necessaire pour la faire* (1612); incisions of great vessels to evacuate blood from the body by scarification are introduced in the embalming procedures. In the same period Pierre Pigray (1532?-1613), physician of Henry IV and Louis XIII, describes the embalming method he applied during his activity in his *Chirurgia* (1609). The techniques of these surgeons were also diffused outside the French boundaries, as demonstrated by the work of Ulisse Aldovrandi (1522-1605): in his *De animalibus insectis* (1638), he reports on similar procedures; Peter Van Foreest (1522-1597), in the *Observationum et curationum medicinalium liber XIX* (1658) describes three different embalming methods, the first of which shows close similarities with the procedures described by French authors.
The same procedure is also followed by authors of the first half of the 17th century. Jean Vigier includes a brief chapter on embalming in his *La grande chirurgie des tumours* (1657), whereas Philibert Guybert (1579?-1633) dedicates an entire text to the subject, *La medécin charitable enseignant la manière d'embaumer les corps morts* (1660); the work by François Ranchin (1564-1641), *De Praeservatione cadaverum a putredine et verminatione*, included in his *Opuscola Medica* (1627) is drawn on by Giuseppe Donzelli (1596-1670) in his *Petitorio Napoletano* (1649).

Fig. 3 - Endocranial cast and mould of the newborn's thorax.

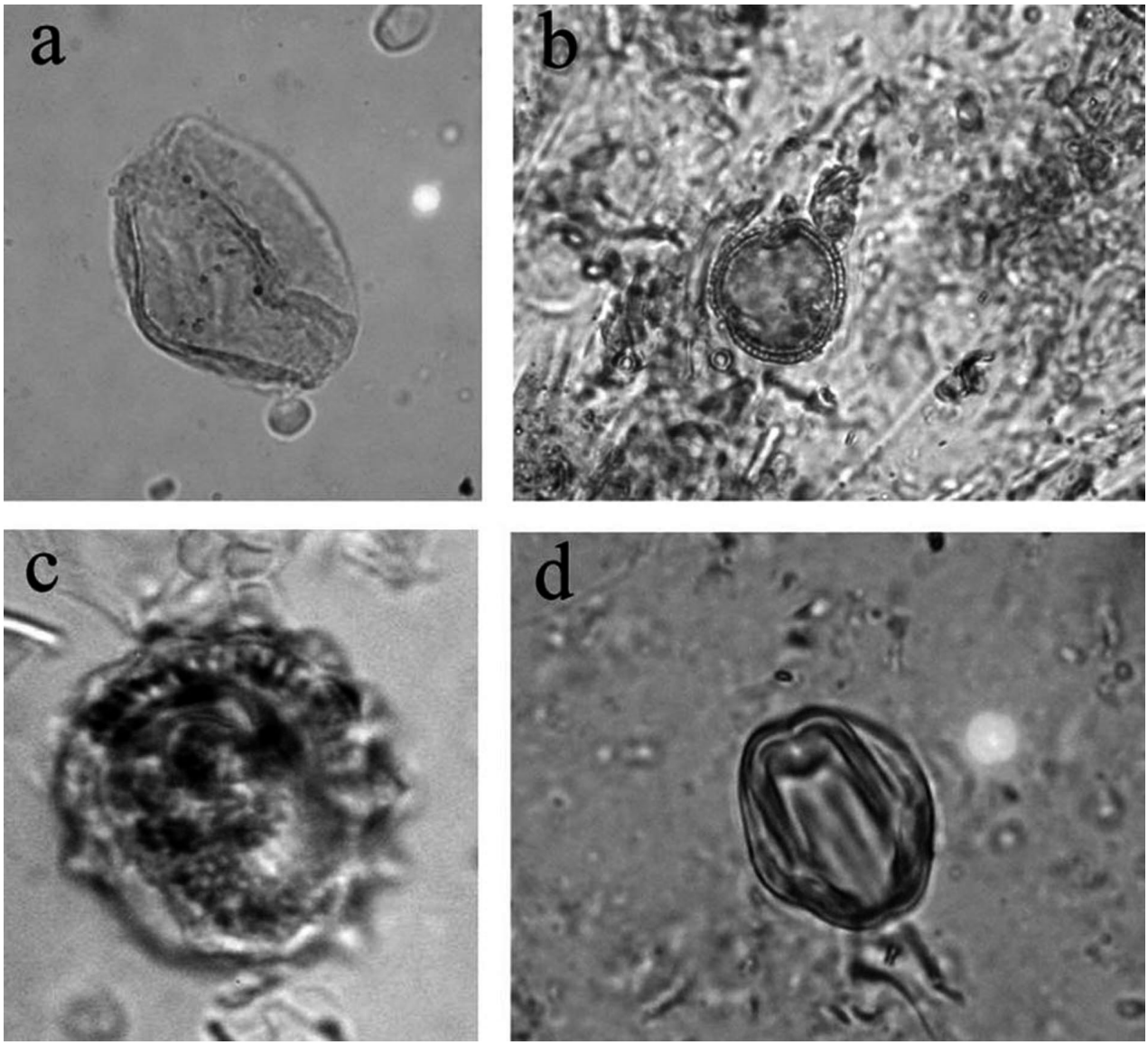

Fig. 4 - Pollen grains at light microscope found in the newborn samples: (a) germander/*Teucrium* (28 μ); (b) olive/*Olea europaea* (25 μ); (c) chamomille/*Matricaria camomilla* (27 μ); (d) grapevine/*Vitis vinifera* (23 μ).

With regard to palynological analyses carried out on the two children's samples, a prevalence of oak, rockrose and aromatic plants of the *Labiatae* family, in particular germander, *Phlomis* and sage, was observed in the thoraco-abdominal cast of the 5-year-old child identified with Don Filippo; the presence of other plants, including poppy, hemp, wheat, rue and other Labiatae, like *Melittis*, mint and *Lamium*, was detected in lower percentages. As for the newborn, the analyses evidenced a strong prevalence of germander, with minor presence of olive, grapevine, pine and chamomile.

In the recipes proposed by authors of the 16th and 17th centuries several substances are mentioned whose pollen was found in the Medici children.

With particular regard to the 5-year-old child, according to Paré, oak ash could be used as filling substance when the surgeon did not dispose of aromatic powders. Oak bark is also mentioned by Pigray to prepare a powder to sprinkle the body both externally and internally, and by Vigier, who prescribes the use of oak ash for more economic embalming.

The pollen of rockrose is to be referred to *labdanum*, a sticky brown resin obtained from the *Cistus ladanifer* shrub. *Labdanum* has a long history of employment as *perfume* ingredient and is mentioned by Foreest, who prescribes it to fill the ears and nostrils, as well as by Ranchin and Donzelli, who mix it with dry powders to fill the body cavities.

The pollen of germander belongs to the genus *Teucrium*, and some of the grains found in the analysed samples should be identified with the water germander (*Teucrium scordium*), named by some authors of the XVII century, in particular by Guybert, who includes the germander among the aromatic plants used to cover the body in the coffin, as well as by Ranchin and Donzelli, who mention this plant for the dry preparations used to fill the body cavities.
In the written sources no mentions to plants referable to the genus *Phlomis* are found. These pollen grains could be explained with an accidental presence, even if the significant percentage let to suppose an intentional use. *Phlomis* are plants of the Labiatae family with sage-like leaves, oval and covered with fine hairs; it cannot be ruled out that in the past *Phlomis* was mistaken for sage or was intentionally collected for its aromatic properties together with other Labiatae.
Sage, as well as mint, is mentioned by all authors as fixed ingredient for dry preparations used to fill the body cavities after evisceration or, in some cases, as aromatic substance to be macerated in brandy to wash the body cavities.
As for the plants whose pollen grains were found in minor percentages, although they could represent an intentional ingredient, and in this case their use should be confirmed by literature, the most likely hypothesis is that their presence is accidental, in particular if no mention is found in contemporary authors. It is in fact probable that the pollen of a variety of species accidentally interfered with plants used in the embalming process and was thus incorporated in the mummies.
Hempen tow was used to fill the body cavities, and was also found as macro-remain in other contemporary mummies (Fornaciari *et al.*, 2008; Giuffra *et al.*, 2011). Hemp tampons are frequently mentioned by contemporary authors.
Rue was used for embalming in different ways; in particular, according to Parè, it was boiled in vinaigre, macerated in brandy as reported by Guillemeau, pulverized to fill the body cavities in the recipes of Foreest and Ranchin, both macerated in brandy to wash the body cavities and pulverized to fill the body cavities according to Vigier, and finally employed among other substances to cover the body within the coffin as said by Guybert.
No authors refers the use of poppy, wheat, *Melittis* nor of *Lamium* (deadnettle), whose pollen grains have been detected, but in low percentages. These values and the lack of references in the literature let to suppose that their presence is accidental; poppy is an infesting species, very common in fields at the beginning of the summer. The presence of cereals, besides to be an accidental presence, can perhaps be interpreted as a sort of flour used as excipient in the «recipes», as observed also in other Renaissance mummies (Giuffra *et al.* 2011), even if no evidence of this procedure are found in the literary sources. As for *Melittis* and *Lamium*, their presence is probably accidental, even if a confusion with similar species, in particular other Labiatae, cannot be excluded.
As for the newborn, although the embalming technique was actually quite similar, palynological analysis showed that the plants for this child were poorer and less variegated than those of the 5-year-old-child. These differences could eventually be due to intentional choices, considering the different ages of these two very young members of the Medici family; a quicker and simpler procedure is likely to have been applied to the small corpse of a newborn rather than to the body of a 5 year-old child. It is also possible to explain these differences by the different ages in which the embalmings were performed.
The presence of germander, strongly prevalent in the newborn, has been already discussed, and seems referable to the water germander mentioned by contemporary authors.
The presence of olive pollen grains should be referable to the use of oil. All authors, except for Pigray, report on the use of oils, perfumed with many aromatic substances such as rose, chamomile and lavender to anoint the body. Olive oil was certainly the base ingredient for these preparations.
The remains of grapevine pollen grains indicate the use of vinegar, brandy or wine, which were constantly mentioned as liquids used to wash the body cavities, essentially with the help of sponges.
The presence of pine pollen grains, although in very low percentages, suggest the employment of resins; in particular common resin is listed by Guillemeau and pine resins are expressly mentioned by Foreest as liquefied substances used to soak the body.
Pulverised chamomile or chamomile flowers are included in dry preparations used to fill the body cavities after evisceration in the recipes of all mentioned authors, excluding Pigray. Parè and Donzelli also list chamomile oil among the substances used to sprinkle the belly.

Conclusions

This work has allowed the analysis of embalming techniques used in Renaissance Florence, between the 16th and the first half of the 17th century. In particular, attention was focussed on the comparison of the botanical species found as pollen grains in two infantile mummies belonging to the Medici family with the documentation obtained from the contemporary medical treatises.
This study represents a unique opportunity to investigate the practice of mummification applied to infantile subjects, opening the path to future similar investigations on other specimens.

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