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Special wood for special people: archaeobotanical evidence of fragrant, local and exotic plants in the Roman cremation necropolis of *Olisipo* (Lisbon)

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ABSTRACT

A section of the Roman necropolis of *Olisipo* (Lisbon, Portugal), dating from the 1st century CE to the 4th century CE, was identified in 2016 at Calçada do Lavra, in the northwestern part of the ancient city. Ninety-three samples from primary and secondary cremation contexts were collected for an archaeobotanical study aimed at better understanding the role of plants in the Roman cremation ritual. The anthracological results revealed a predominance of *Pinus pinaster*, prompting a discussion of whether the selection of firewood prioritised local availability, functional properties, or symbolic meaning. Species of economic interest, such as *Ficus carica* and *Olea europaea*, were also recorded in significant numbers, suggesting the presence of arboricultural practices in the vicinity of the city. Finally, several seeds and fruits were also found, including the first evidence of *Myrtus communis* fruits in a cremation context in the geographical and chronological framework of the Roman Empire.

Overall, the selection of wood seems well-suited to the practical requirements of building funeral pyres. However, the presence of charcoal and carpological remains of fragrant plants and species with well-known symbolic value in the Roman world suggests that the fuel and offerings used in the pyres served sensory and ritualistic purposes.

1. Introduction

In the ancient Roman world, funeral rites (*funus*) were perceived not only as a means of disposing of the deceased's body but also as a complex and essential rite of passage, governed by a set of strict rules and protocols. They not only meant to purify the individual's soul, polluted by death, but also provided an important moment of mourning for their family (Toynbee, 1971; Hope, 2007; Pearce, 2000; Williams, 2004; Weekes, 2005). Among the various existing rites, cremation established itself as the prevailing one from the 2nd century BCE to the 2nd century CE, having been even described by Tacit (Ann. XVI.6) as the *romanus mos* (the Roman way).

Nevertheless, written and iconographic evidence describing this practice often refers to exceptional events or prominent public figures (Noy, 2000; Toynbee, 1971), resulting in limited knowledge of common cremation practices across the Empire. Archaeobotanical studies play a fundamental role in bridging that gap and have great potential to shed light on the roles that food and wood played in these complex social

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events. This is particularly relevant in the provinces far from Rome, where there is no written evidence of these rituals, and regional adaptations conciliating indigenous beliefs may have occurred. Several archaeobotanical studies have sought to address this issue across different regions of the Western and Eastern Roman Empire. These have been focusing particularly on the construction of funerary pyres (e.g. Figueiral et al., 2010), the presence of personal objects and furniture (e.g. Fabre et al., 2003; Figueiral et al., 2010), the symbolic and functional criteria present in wood selection (e.g. Martín-Seijo and Vila, 2019; Bianco et al., 2023), the meaning of certain fruits and seeds (e.g. Robinson, 2002; Bouby and Marinval, 2004) and the difference between pyre offerings and secondary deposition (e.g. Preiss, et al., 2005; Matterne and Derreumaux, 2008).

Despite this growing interest in archaeobotanical research, these kinds of studies remain scarce on the Atlantic façade of the Iberian Peninsula, with two notable examples relating to necropolises such as the necropolis of *Via XVII* of *Bracara Augusta* (Braga, Portugal) (Vaz et al., 2021) and the necropolis of Peñascon (Extremadura, Spain) (Espino, 2004).

Thus, the excavation of a large necropolis in the ancient city of *Olisipo*, now Lisbon (Portugal), provided an opportunity to substantially improve our knowledge of cremation practices and the role of plants in this ritual during the Roman period. On the other hand, the city of *Olisipo* was founded well before the Roman conquest of *Hispania,* and it is important to understand how Roman funeral rituals were adopted by the communities that lived there. This work addresses these issues based on archaeobotanical evidence, in articulation with other archaeological information.

2. *Olisipo* and the necropolis of *Calçada do Lavra*

The site of Calçada do Lavra is an integral part of the so-called Northwest Necropolis, which extended along the banks of the "Via do Norte," a key road axis of the city of *Olisipo*, crystallised in Rua das Portas de Santo Antão (Fig. 1). The archaeological intervention that led

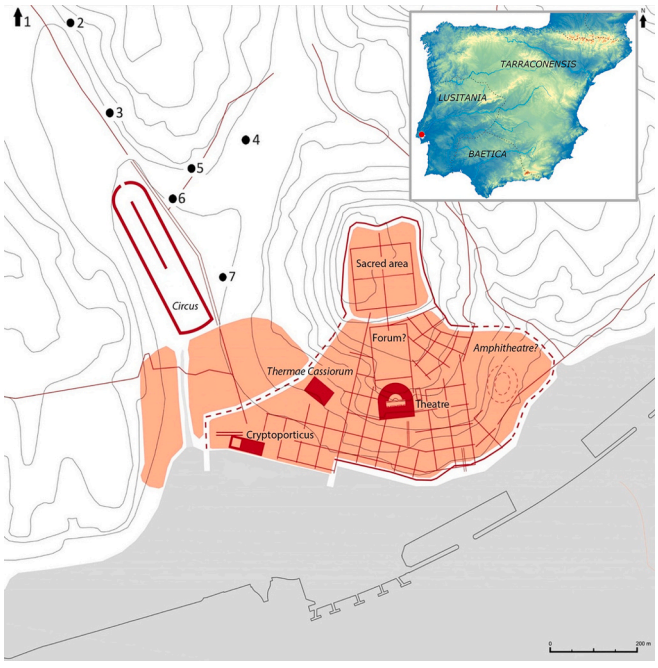


Fig. 1. Location and funerary nuclei belonging to the Northwest Necropolis of *Olisipo*. Legend: (1) Rua de Santa Marta; (2) Calçada do Lavra; (3) Rua das Portas de Santo Antão; (4) Encosta de Sant'Ana; (5) Calçada do Garcia; (6) Largo de S. Domingos; (7) Praça da Figueira (
Adapted from Mota and Martins, 2020).

to the identification of the site took place between 2017 and 2018, as part of the mitigation measures prescribed for the expansion project of the Solar dos Presuntos restaurant. It involved the manual excavation of an area of about 300 square meters.

During the excavation, approximately 50 funerary contexts were documented (Sousa, 2024; Sousa et al., 2025). Most are remains of the cremation ritual, materialised in *busta* – structures with or without a monumental character, where the remains from the incineration process were deposited, along with the votive offerings (Fig. 2). Additionally, 23 simple inhumation graves were identified, from which 25 individuals were exhumed, 18 of whom were considered immature. Two funerary urns were also collected.

Most of these funerary structures were associated with a votive set consisting of one or two small pots, an oil lamp, bowls or plates in common ceramics or clear African *Terra Sigillata*, and a coin. Exceptionally, some featured glass *unguentaria*, or ceramic ones in the form of small *amphorae*, as well as metal and bone instruments associated with the individual's professional activity.

In general, these materials date from the late 1st century CE to the late 4th century CE. More specifically, the cremation burials span from the late 1st century CE to the late 4th century CE, while the inhumation burials date between the 2nd century CE and the 4th century CE.

3. Materials and Methods

3.1. Sampling and processing

During the excavation, 37 cremation contexts were identified and numbered in the order in which they were unearthed. A total of 93 samples, corresponding to 718 L of sediment from 68 stratigraphic units, were recovered from 35 of these contexts. In most cases, a single sample was collected per context; however, in 18 cremation contexts, between 2 and 7 samples were obtained based on field-based sampling decisions and the characteristics of the deposits (See Table 1 below and Table 1 in Supplementary Materials).

These analysed contexts comprised 13 primary contexts (*busta*), referring to *in situ* accumulations of charcoal and burnt bone where the pyre was built and the cremation occurred (Fig. 3), and 22 secondary contexts, interpreted as the redeposition of a portion of the cremation remains alongside the funerary urn and other funerary offerings (Fig. 4). The cremation did not take place there, but possibly in a *ustrinum*. Secondary contexts were the most frequently observed.

In addition to these contexts, samples were recovered from a *ustrinum* of recurrent use (Cremation 28), where multiple cremation events took place, and from three similar contexts (Cremation 32/33/35), which are small negative features with no apparent funerary function and interpreted as structural elements of the *ustrinum*.

Once recovered, the samples were processed using a Siraf-type flotation machine with a 0,5 mm mesh. Due to their high clay content and compactness, 11 samples were submerged in a 10% hydrogen peroxide solution (10 cl/L) for 24–48 h to be deflocculated. Several studies have established that this method is the most effective for deflocculating clayey soils, as its action weakens the bond between clay particles and prevents further fragmentation of the recovered plant remains (e.g. Pearsall, 2017).

3.2. Charcoal remains

The study of charcoal remains followed standard methodology. Charcoal fragments over 2 mm were manually sectioned according to their three diagnostic sections – transversal, tangential and radial. They were then observed under a stereomicroscope and a reflected-light microscope at up to 500 × magnification. Taxonomic identification was made by comparing their anatomical characteristics with reference atlases of wood anatomy (e.g. Schweingruber, 1990; Vernet et al., 2001). In the specific case of the Ericaceae, the anatomical types defined

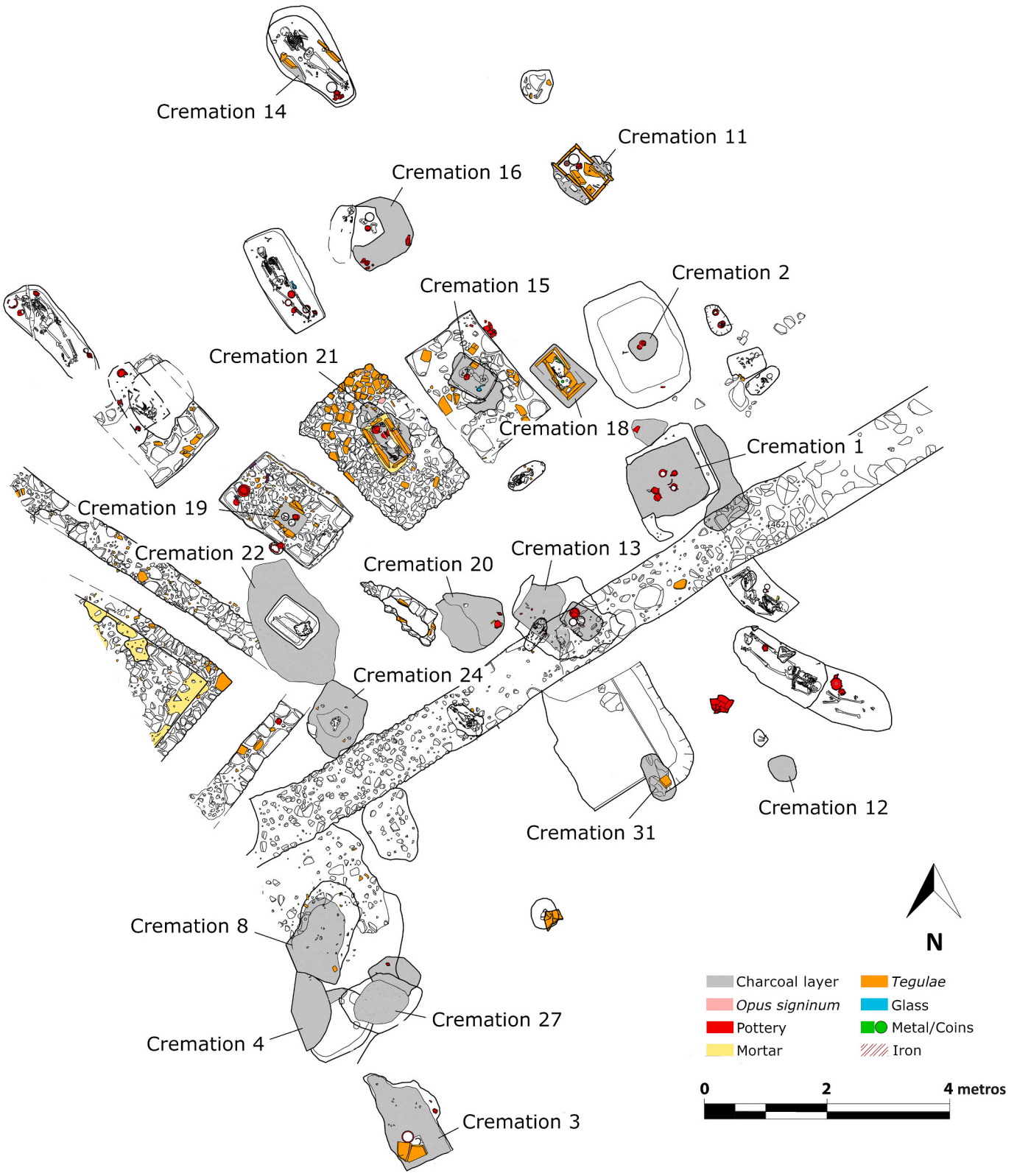


Fig. 2. Plant of the Calçada do Lavra excavation showing the cremation contexts. Created based on two field drawings produced for the report on the archaeological intervention (Rebelo et al., 2020).

by Tereso (2007), based on the work of Queiroz and Van der Burgh, were adopted. In the case of the genus *Quercus*, identification to species level is often difficult; therefore, the nomenclature *Quercus* sp. type deciduous and *Quercus* sp. type evergreen was used.

In addition, a group of dendrological characteristics and anatomical alterations capable of providing paleoethnobotanical data were also recorded for each charcoal fragment, such as tree-ring curvature (Marguerie and Hunot, 2007) and the presence of bark/pith, vitrified tissue (McParland et al., 2010), radial cracks (Théry-Parisot and Henry, 2012) and biodegradation (Moskal-Del-Hoyo, 2012). It should be noted,

Table 1
Inventory of the primary and secondary contexts sampled.

Chronology	Type of context	Number of contexts	Vol. (L)
End of 1st c. – 3rd c.	Secondary	1	2
End of 1st c. – 4th c.	*Bustum*	7	204
	Ustrinum	1	32
	Secondary	18	240
	Remobilisation of a funerary context	1	2
2nd c. – 3rd c.	*Bustum*	3	141
	Secondary	1	1
Second half of 2nd c.	Secondary	1	23
Second half of 2nd c. – First quarter of 3rd c.	*Bustum*	1	17
Second half of 2nd c. – 4th c.	Secondary	1	36
End of 2nd c. – 3rd c.	*Bustum*	1	20
Total		**36**	**718**

however, that the Marguerie and Hunot curvature method is highly approximate and not as reliable as more quantitative approaches, such as anthracotypology (e.g. Dufraisse et al., 2018). While it remains useful in the absence of alternative indicators, its results should be considered only broadly indicative and interpreted with caution.

To obtain a good characterisation of the anthracological assemblage, a minimum of 150 fragments was set as the target for analysis per sample (Kabukcu and Chabal, 2021). Suppose a new taxon was identified in the interval between 100 and 150 charcoals; a further 50 fragments would be analysed until no new taxa emerged. In cases where there wasn't enough identifiable material to reach the minimum number, the samples were analysed in their entirety.

3.3. Fruits and seeds

Light fractions were sorted to recover fruits and seeds using a stereomicroscope at up to 80 × magnification. Identification was carried out with the assistance of specialised literature (e.g. Jacomet, 2006; Nesbitt, 2006; Neef et al., 2012; Zohary et al., 2012) and by comparison with modern material from the reference collections of the Herbarium of the Natural History Museum of the University of Porto (PO) and CIBIO.

4. Results

4.1. Charcoal remains

The study of the anthracological assemblage resulted in the analysis of 7663 charcoal fragments (see Table 2 below and 3 in the Supplementary Materials). The most frequent taxon was *Pinus pinaster* (maritime pine) (31,3%), followed by *Ficus carica* (fig tree) (11,2%), *Olea europaea* (European olive) (10,7%), *Fraxinus* sp. (ash) (8,7%), *Quercus* sp. type evergreen (evergreen oaks) (5,5%), Rosaceae Maloideae (5,4%), *Cistus* sp. (rockrose) (3,5%), *Pinus pinea/pinaster* (stone/maritime pine) (2,8%), *Quercus* sp. (2,0%), *Quercus suber* (cork oak) (1,9%), *Fagus sylvatica* (European beech) (1,8%), *Quercus* sp. type deciduous (deciduous oaks) (1,6%) and *Laurus nobilis* (laurel) (1,5%). The remaining taxa accounted for less than 1% each (Fig. 5).

This assemblage stands out for its apparent lack of spatial patterns (Fig. 1 in Supplementary Materials), while the detection of chronological differences is hindered by the ample and overlapping chronology of the contexts. Nevertheless, *Pinus pinaster* was the most ubiquitous taxon in the study, having been identified in 30 of the 35 contexts analysed. A second group of taxa, comprising *Olea europaea*, *Fraxinus* sp., *Quercus* sp. type evergreen, *Pinus pinea/pinaster* and *Cistus* sp., is also consistently present in more than half of the contexts (Table 3 in Supplementary Materials).

Cremation 18 contained the most diverse assemblage, comprised of 17 taxa. It was also the only context in which *Frangula alnus* (water leech) and *Prunus* sp. were observed. These occurrences appear to be in tandem with the exceptional nature of this cremation context, where an impressive set of votive materials possibly associated with a medicinal practice was collected, such as a bronze box with several interior divisions, a metal case, various stilettos, a ring, a gold earring and two stone slabs (*cuticulae*) used for crushing and mixing medicine (see below).

Weak tree rings curvatures were predominant in the most frequent arboreal taxa, such as *Olea europaea* (8,6%). Strong curvatures were systematically identified in *Cistus* sp. (61%) and *Vitis vinifera* (grapevine)



Fig. 3. Example of a primary context – *bustum* (Rebelo et al., 2020).



Fig. 4. Example of a secondary context (Rebelo et al., 2020).

Table 2
Anthracological results.

Taxon	Total	Ubiquity
Alnus sp.	18	1
Arbutus unedo	7	6
Cistus sp.	267	18
Erica scoparia/umbellata	45	4
Erica sp.	22	3
Fabaceae	4	2
Fagus sylvatica	141	6
Ficus carica	860	13
Frangula alnus	6	1
Fraxinus sp.	667	20
Laurus nobilis	114	2
Olea europaea	821	21
Pinus pinaster	2397	18
Pinus pinea	9	2
Pinus pinea/pinaster	216	30
Prunus sp.	4	1
Quercus suber	143	16
Quercus sp. type deciduous	125	13
Quercus sp. type evergreen	421	19
Quercus sp.	157	13
Rosaceae Maloideae	415	14
Salix/Populus	3	1
Ulmus sp.	61	9
Vitis vinifera	23	7
Dicotyledon	716	32
Monocotyledon	1	1

(65%). Regarding other anatomical and dendrological characteristics, it is worth noting the occurrence of radial cracks, vitrification, biological degradation (xylophagous galleries), and reaction wood (Table 4 in Supplementary Materials).

Radial cracks were detected in 7% of all the charcoal analysed. *Olea europaea* was the taxon in which this alteration occurred most frequently, accounting for 24% of the cracks observed.

Vitrification was present in 8,4% of the assemblage, mostly in *Quercus* sp. (38%), *Olea europaea* (31%) and Dicotyledons (27%).

As for biological degradation, it was only present in 6,4% of the charcoal. *Pinus pinaster* (14%) was the taxon where it appeared most frequently. Similarly, reaction wood was recorded in 11,6% of *Pinus pinaster* and 3,8% of the anthracological assemblage.

4.2. Fruits and seeds

Amongst the 35 cremation contexts analysed, only ten (Cremations 2, 4, 5, 6, 7, 11, 13, 14, 35 and 36) did not provide any carpological material. While the absence of fruits and seeds in some of these contexts can eventually be related to the low volume of sediment recovered (1 – 2 L), that is not the case of others, where 10 to 25 L of sediment were processed (see Table 1 in Supplementary Materials for the volume of each context). The remaining 25 cremations yielded 1,214 fruit and seed remains, including fragments (see Table 3 below and Table 5 in Supplementary Material). A large number of those (n = 519, 43%) correspond to undetermined plant remains, chiefly due to their high fragmentation. Nevertheless, a diverse assemblage (Fig. 9) was observed, particularly in the contexts with more fruit and seed remains, such as Cremation 27 and the *ustrinum*.

Cereals were scarce, occurring in only four cremation contexts. The majority of the samples show fragmented, poorly preserved Triticeae grains. A few grains of hulled *Hordeum vulgare* (barley) and *Triticum aestivum/durum* (naked wheat) were collected, the former in Cremations 3 and 31, and the latter in Cremation 1. Wild grasses were commonly found but were frequently identified only to the family level (Poaceae).

Fragmentation and poor preservation of pulses also often led to identifications with little taxonomic detail. Scarce seeds of *Vicia/Lathyrus/Pisum* may have come from cultivated plants, while the remaining pulses are likely wild. The recurrence and quantity of *Trifolium*-type seeds were significant.

Calçada do Lavra yielded macroremains of three different fruits: *Ficus carica* (fig) achenes, *Vitis vinifera* (grape) pips, and *Myrtus communis* (myrtle) seeds and fruits. Fig was observed in four contexts, two of them with fig tree wood; myrtle in five; and grape in six, with all three simultaneously identified in two contexts (Cremation 18 and the *ustrinum*). Myrtle berries (Fig. 9) were recorded in a single context (Cremation 33).

Brassica/Sinapis seeds were often collected (8 contexts) and in substantial amounts (n = 111). Challenges with distinguishing charred

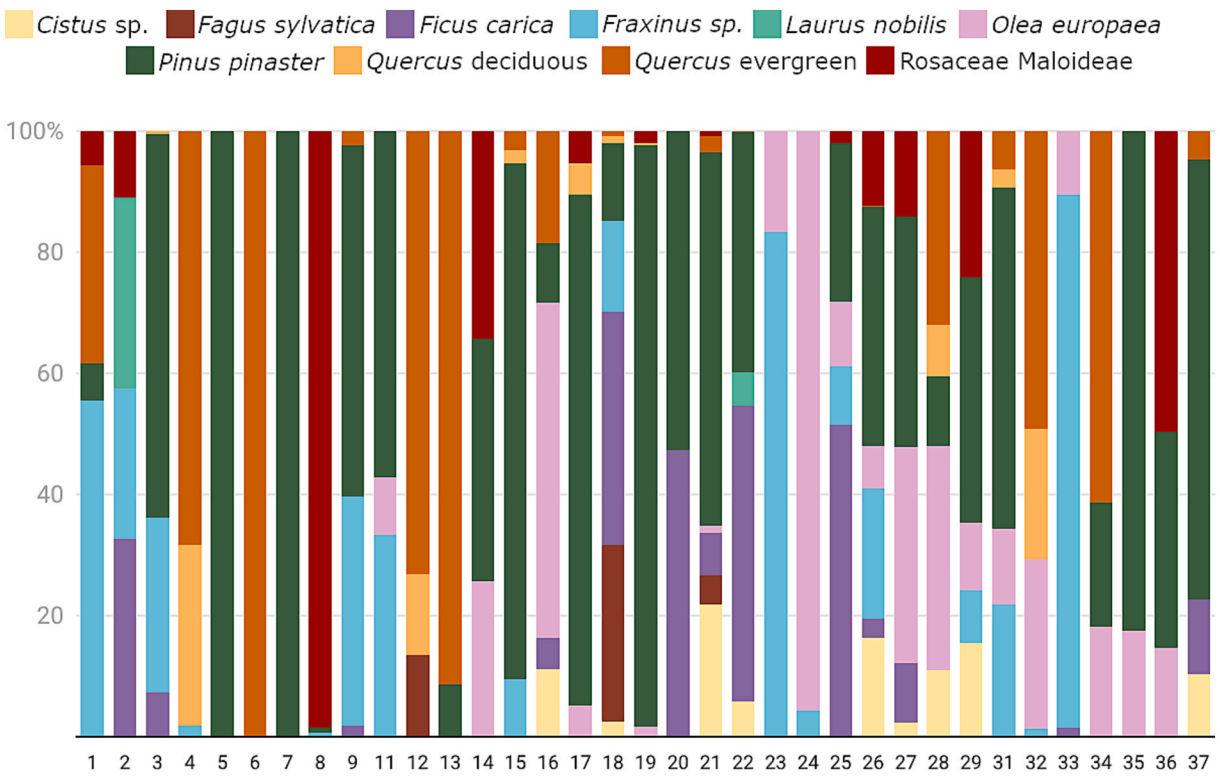


Fig. 5. Relative distribution of the main taxa by context. The horizontal axis shows the sampled contexts, while the vertical axis shows the relative frequency of charcoals identified in each context. Taxa with less than 10 fragments and charcoal identified as Dicotyledons are not included. Contexts were numbered in the order in which they were unearthed.

Brassica and *Sinapis* seeds are well known (Zohary et al., 2012; Bosi et al., 2022), and in this study, detailed identification was also not possible. Remains may come from crops or wild plants, which consequently limits their interpretation. Similarly, a considerable number of *Beta* sp. remains were also recovered (n = 86), almost all corresponding to fruits. These may reflect the presence of cultivated beet (*Beta vulgaris*) or wild sea beet (*Beta vulgaris* subsp. *maritima*), as they are difficult to distinguish (Zohary et al., 2012), and sea beet occurs naturally in the region. The macroremains of both *Brassica/Sinapis* and *Beta* sp. were mainly recovered in the *ustrinum*, the context with the highest concentration and diversity of fruit and seed remains at Calçada do Lavra (Table 5 in Supplementary Material).

The remaining assemblage was constituted of diverse wild plant remains, some of them collected in significant amounts and/or recurrently found, such as *Malva* sp. seeds, *Fumaria* sp. fruits, *Rumex obtusifolius/crispus/conglomeratus* achenes, or siliculae of *Rapistrum rugosum* (turnip weed).

5. Discussion

The building of a funeral pyre was a complex task aimed at fulfilling all the requirements for the complete cremation of a body. Part of this task involved selecting types of wood most suitable for pyre construction, considering the size and shape of logs and their calorific potential. In this regard, several studies on Roman cremations (e.g., Fabre et al., 2003; Figueiral et al., 2010; Coubray, 2013; Cenzon-Salvayre, 2014; Martín-Seijo and Vila, 2019; Vaz et al., 2021; Bianco et al., 2023) have shown that the criteria for selecting wood would take into account not only its local availability, but also its functional qualities. In addition to these factors, it must also be considered the symbolic, superstitious, and religious meanings associated with the species used (Robinson, 2002; Rovira and Chabal, 2008), although these are difficult to identify from an archaeological perspective.

As a result, the charcoal assemblage discovered in Calçada do Lavra will now be examined to uncover its functional and symbolic roles by incorporating paleoecological data that provides information on species availability. Subsequently, other plant offerings will also be analysed by integrating carpological and charcoal data.

5.1. Pyre construction and wood supply

The characterisation of available wood resources in the surroundings of *Olisipo* relies on existing pollen data, which provides a regional overview of woodland and vegetation dynamics, placing wood availability and supply in context. For the region of Lisbon, palynological data comes primarily from studies along the southwestern Portuguese coast, which span a long diachrony (Mateus, 1992; Queiroz, 1999), and from a more recent study conducted in the riverine area of the city (Curràs et al., 2021), which encompasses the dynamics of ancient *Olisipo* during the first six centuries of our Era.

In that regard, data relating to the 1st century CE from the latter study (Curràs et al., 2021) depicts an open landscape around the city with small tree cover (especially from evergreen oak-dominated communities) and shrublands composed of *Erica* spp., *Cistus ladanifer*, and most likely *Olea*, whether wild or domesticated. Although *Pinus* is also present throughout the sequence, it is surpassed by Ericaceae and Poaceae, being more aligned with herbaceous synanthropic taxa such as *Plantago* and Brassicaceae. Pollen records from the first studies (Mateus, 1992; Queiroz, 1999) complete the picture by showing deforestation phases associated with the expansion of farmlands, with frequent detection of pollen from anthropogenic activities (such as Cerealia/Poaceae), and shrubland formations dominated by *Erica scoparia*. At the turn of the Era and during its first two centuries, forest cover declined to a minimum in neighbouring areas of Lisbon, where natural forests of pine, oak and alder almost disappeared.

This was the scenario in which wood gathering took place, and the

Table 3
Main carpological results.

Cereals (grains)	Total	Ubiquity
Hordeum vulgare	3	1
Triticum aestivum/durum	1	1
Triticum sp.	2	1
Triticeae	15	2
Other Poaceae (grains)		
Phalaris sp.	2	1
Poa sp.	1	1
Poaceae	42	8
Fabaceae (seeds)		
Vicia/Lathyrus/Pisum	4	3
Vicia/Lathyrus	5	4
Scorpiurus sp.	1	1
Fabaceae – type *Medicago*	3	2
Fabaceae – type *Trifolium*	45	9
Fabaceae	13	5
Fruits		
Ficus carica (seed)	31	4
Myrtus communis (seed/fruit)	28	5
Vitis vinifera (seed)	12	4
Others		
Apiaceae (achene)	2	2
Asteraceae (cypsela)	11	5
Beta vulgaris (fruit/seed)	73	4
Brassica/Sinapis (seed)	85	8
Brassicaceae (pedicel/fruit)	6	1
Caryophyllaceae (seed)	4	1
Chenopodiaceae (seed)	16	7
Fumaria sp. (fruit)	29	3
Galium sp. (mericarp)	1	1
Malva sp. (seed)	66	8
Papaveraceae (seed)	1	1
Rapistrum rugosum (siliculae)	13	6
Rumex sp. (achene)	28	9
Sherardia arvensis (mericarp)	3	1

city's pyres were provisioned. As mentioned before, the wood selection was closely linked to pyre construction and the need to maintain a long-lasting fire. As such, even in a period when forested areas were short, there was a need for large pieces of wood, whose supply must have been guaranteed in any way, by increasing catchment areas or by importing from other areas if needed.

Looking now at the anthracological set discovered in Calçada do Lavra, it is evident that *Pinus pinaster* is the most frequent and ubiquitous taxon throughout. The use of this species for building funerary pyres has been repeatedly noted in other archaeobotanical studies of Roman cremation contexts, both in Iberia (Espino, 2004; Vaz et al., 2021; Martín-Seijo and Vila, 2019; Bianco et al., 2023) and in various other European studies (e.g., Kreuz, 2000; Fabre et al., 2003; Figueiral et al., 2010; Moskal-del-Hoyo, 2012; Cenzon-Salvayre, 2014). This may be due to the high flammability of its wood (Cenzon-Salvayre, 2014) or the pleasant aroma released by its resin, which could have helped mask the unpleasant odours of cremation (Moskal-Del-Hoyo, 2012; Martín-Seijo and Vila, 2019). Furthermore, the naturally cylindrical, straight and slender shape of its trunks made it suitable for building pyres, with the use of whole trunks being even documented in this study, as evidenced by the recurring presence of *Pinus* fragments with varying degrees of curvature. Regarding its symbolic significance, the pine tree was viewed by the Romans as a mediator between life and death (Rovira and Chabal, 2008), a belief that may have contributed to its frequent use in cremations.

Although any ritualistic use of pine wood cannot be discarded, its presence at Calçada do Lavra can also be justified by its availability in the region. Pine forests were among the primary tree formations in the surrounding area (Gomes, 2011; Gómez-Orellana et al., 2014), and although they did not occupy the extensive areas that characterised the region in the Early Holocene (Mateus, 1992; Queiroz, 1999), it is known that they remained a source of fuel in Roman times, as supported by the evidence from this study and other sites such as Alcáçova de Santarém (Tereso et al., 2025).

Moving on to *Ficus carica* (Fig. 7) and *Olea europaea*, they were the second and third-most frequently identified taxa at Calçada do Lavra. Their presence, along with other species of potential economic value (Rosaceae Maloideae, *Laurus nobilis, Vitis vinifera,* and *Prunus* sp.), may indicate ongoing arboricultural practices, which have been present in Lusitania, as in other Western Mediterranean regions, since the Phoenician period (Pérez-Jordà et al., 2021a). Therefore, some of the charcoals analysed may relate to the use of pruning and tree-management waste, as suggested by the high incidence of strong curvatures in the *Vitis* fragments. This theory is ultimately supported by pollen evidence from *Olisipo*, which documents an increase in the cultivated area of the species during the Roman era, especially after the 2nd and 3rd centuries AD (Curràs et al., 2021).

On the other hand, it was impossible to characterise curvature in most fragments of *Olea* and *Ficus*. However, in those where such information was obtained, there is a predominance of weak curvatures, coupled with the scarcity of strong curvatures. This appears to indicate the use of the trunk rather than small branches, although the high number of indeterminates demands some caution. In the case of *Olea,* firewood may have derived from wild olive trees growing in the region, considering that olive groves played a vital economic role in olive oil production, and the cutting of mature trees was probably rare. In addition to its widespread local availability, this type of wood was renowned for its excellent combustibility, notably its slow, long-lasting burning (Coradeschi et al., 2023). As for *Ficus*, the presence of weak and moderate curvatures is harder to justify since, although it is an autochthonous species, wild populations were unlikely to have been common during this period, if they existed at all. Hence, it is possible that its wood played a role in the ritual that went beyond any practical purpose. However, it should be emphasised that curvature analysis provides only a broad approximation, and that more quantitative approaches are required to validate these observations. The other taphonomic features observed in the assemblage, such as radial cracks, vitrification, biological degradation and tension wood, did not yield conclusive results.

The interpretation of the presence of these species must also consider their symbolic and sensory dimensions, reiterated by classic authors such as Statius (*Silv*. V, 1.88), Ovid (*Met*. VII, 498), and Virgil (*En*. V, 246; VIII, 116; *Buc*.). Firstly, *Ficus* was associated with longevity, immortality, and wealth (Rovira and Chabal, 2008). It also released a pleasant aroma that could have been used to mask the odours of cremation. *Olea*, in turn, held several symbolic meanings, such as chastity, virtue, hope, and eternal peace (Rovira and Chabal, 2008), as well as economic and gastronomic significance for Mediterranean communities (Loumou and Giourga, 2003). Similarly, *Laurus* was regarded as a symbol of victory, triumph, and glory in the Mediterranean world since the days of Ancient Greece, when it was used to reward winning athletes (Virg. *En*. V, 246). In Rome, that distinction was granted to victorious generals who entered the city in triumph (Flory, 1995). As for its combustible properties, its wood emitted a crackling sound when burned, which may have been used to enhance the sensory experience typically accompanying the cremation ritual (Virg. *Buc*. VIII, 22). As for *Vitis, it* was associated with hope, longevity, and resurrection (Rovira and Chabal, 2008). These fruit-bearing taxa may have been gathered either from the surrounding landscape or from funerary gardens associated with the necropolis, where both fruits for funerary banquets and wood for the pyre could have been obtained. The presence of such funerary gardens in Roman necropolises is well attested in classical literary sources (CIL XIII, 5708), epigraphy (Marzano, 2022)

and archaeobotanical studies in Iberia and Italy (e.g. Jashemski, 1994; De Heredia et al., 2007). Looking now at *Fraxinus* sp. and *Quercus* sp. type evergreen, they stood out for their frequency and ubiquity (57,1% and 54,2%, respectively). Their presence in Roman cremation contexts has been recorded throughout Europe (e.g. Figueiral, 1996; Kreuz, 2000; Fabre et al., 2003; Challinor, 2006; Figueiral et al., 2010; Coubray, 2013; Deforce and Haneca, 2012; Moskal-del-Hoyo, 2012; Cenzon-Salvayre, 2014; Figueiral et al., 2017; Martín-Seijo and Vila, 2019; Vaz et al., 2021), being linked to both their ample local availability and properties that facilitate combustion. In fact, both are medium to large trees that produce substantial amounts of wood and are, therefore, capable of fuelling several pyres. While oak wood is hard and dense and can easily reach the extremely high temperatures needed for cremation (Figueiral, 1996), ash wood is better known for its sustained combustion and its ability to burn either dry or green (Martín-Seijo and Vila, 2019).

In southwestern Iberia, evergreen oaks are known to form climacic forests (e.g., cork-oak – *Quercus suber* – forests) and shrublands (e.g., dominated by *Q. coccifera*) or subserial communities, playing a significant role in the region's ecosystems (Figueiral, 1996). *Fraxinus angustifolia*, on the other hand, creates riparian forests alongside other trees such as *Ulmus minor*, *Alnus glutinosa*, *Salix* spp., *Populus* spp., and *Frangula alnus*, which are also present in the Calçada do Lavra assemblage, albeit some identified only at the genus level. These ecosystems still exist nowadays along the Tagus basin, despite pollen data suggesting intensive exploitation of their habitat in the first half of our Era, ultimately resulting in their notable reduction (Curràs et al., 2021; Portela-Pereira, 2013).

Finally, it is worth noting the presence of small-calibre wood identified in the anthracological assemblage, originating particularly from *Cistus* sp. and *Erica* sp. Shrubs were often used as fire starters, being mixed with the larger logs required for a continuous combustion. Although these species show fewer charcoal pieces due to their small size and lower resistance to fire, the high prevalence of *Cistus* sp. (present in 51,4% of contexts) indicates that rockroses played a vital role in these cremations. The different percentages across various funerary structures may also reflect the diverse functions of these small species, which could have been chosen not only as kindling (Cenzon-Salvayre, 2014; Fabre et al., 2003), but also as aromatic or decorative agents (Picornell et al., 2018), or even for their symbolic significance as perennial plants (Rovira and Chabal, 2008). In the case of *Erica* sp., it reaches a high frequency in pollen data from downtown Lisbon (Curràs et al., 2021), surpassing any tree and suggesting, again, the open and/or successional facies of the landscape surrounding the area. These shrubs were thus an easily accessible source of firewood.

5.2. Plant offerings

During the cremation ritual, offerings to the deceased could be made at two different times. The first was just before the pyre was lit. Family members would place items beside the body that represented the individual, including furniture (e.g., beds, chairs), personal hygiene objects made of wood or bone, jewellery, containers for eating and drinking made of glass, wood or ceramics, as well as food and animals, sometimes including their pets (Toynbee, 1971; Williams, 2004; Weekes, 2005). The second occasion was during the *silicernium* – a ritual banquet shared by the family around the pyre while the cremation took place (Toynbee, 1971). During this event, some of the food was offered to the deceased, and the remnants of the rest (e.g. stones, pits, shells) were discarded into the fire. As a result, the carpological remains found in cremation contexts are most likely connected to this practice.

At Calçada do Lavra, offerings were identified through both anthracological and carpological analyses, corresponding to the two occasions mentioned above. In the first instance, charcoal fragments of *Fagus sylvatica* (Fig. 6) were recovered from six different structures, notably in the exceptional contexts of Cremation 18 and Cremation 21. This species has been sporadically recorded in Roman cremation contexts across Europe (e.g. Deforce and Haneca, 2012; Moskal-del-Hoyo, 2012; Figueiral et al., 2017), including Portugal (Vaz et al., 2021), and is sometimes linked to trade and long-distance wood supply (e.g. Vaz et al., 2021). Its current distribution in Portugal is limited to ornamental trees and plantations in Serra do Gerês (Honrado, 2003). However, some palynological studies (Ramil et al., 1998, 2000) have identified *Fagus* in this region of northwest Portugal around the Middle Holocene, and vestigial populations may have persisted there until recent times (Vaz et al., 2021). Since Lisbon is far from possible refuges for this species, the charred wood found in this study is more likely to have arrived in Calçada do Lavra as objects or furniture, possibly used as votive offerings in the cremations of socially prominent or wealthy individuals.

The fragments showed no evidence of woodworking, but they measured only up to 2 mm, making the preservation of such traces unlikely. Nevertheless, this hypothesis is supported by other material evidence found in Cremation 18 and Cremation 21, where the largest sets of beech wood were identified. In the former, several bronze objects, which led to the identification of the deceased as a doctor or surgeon, were recovered (Fig. 8). In the latter, a set of 32 glass game pieces and two bone dice were found (Fig. 8). These items indicate the deceased's high status, which could explain the presence of exotic wood. The residual presence of beech wood in Cremation 19 may be due to intrusions, given its proximity to Cremation 21. Although *Fagus* provides the most compelling anthracological evidence for the deliberate deposition of plant-derived offerings at Calçada do Lavra, it is plausible that other taxa may likewise have been introduced as part of objects, furniture or other symbolic elements associated with the funerary ritual. In most instances, however, the evidence is insufficient to distinguish such practices from the use of firewood.

Looking now at the carpological finds, they were the most common evidence of plant offerings found at Calçada do Lavra. However, just as the archaeobotanical assemblage does not represent all plants involved in the cremation ritual, not all macroremains found may be directly related to those activities (e.g., Kreuz, 2000; Bouby and Marinval, 2004; Cooremans, 2008; Rottoli and Castiglioni, 2011; Lodwick, 2017; Reed et al., 2019). Therefore, the diverse set of fruits and seeds identified in this study, including cereals, pulses, fruits, and various wild taxa, requires careful analysis of their association with, or lack thereof, funerary practices.

The cereal grains collected allowed the identification of hulled barley and naked wheat. However, no clear pattern was observed, apart from the lower diversity of macroremains in the contexts containing cereals (see Table 5 in the Supplementary Material). Due to the limited assemblage, it remains difficult to assess the significance of these plants in the funerary ceremony. Nonetheless, cereals, especially naked wheat and hulled barley, are common finds in funerary contexts across other European regions influenced by Rome (e.g., Bouby and Marinval, 2004; Cooremans, 2008; Rottoli and Castiglioni, 2011; Reed et al., 2019; Marzano, 2022), and would likely have served as important offerings, which was also probably the case at Calçada do Lavra.

Regarding pulses, detailed considerations are limited by the poor preservation and scarcity of the remains recovered in this study. Nevertheless, the large, seeded Fabaceae identified as *Vicia/Lathyrus/Pisum* found in three contexts suggests that domesticated pulses may have been part of the funerary rituals in this necropolis, their use as funerary offerings being supported by several written sources and archaeobotanical data across Europe (e.g. Bouby and Marinval, 2004; Rottoli and Castiglioni, 2011; Reed et al., 2019; Vaz et al., 2021; Marzano, 2022).

The record of fruits, including those imported or introduced during the Roman period, has also been highly prominent in funerary contexts across this continent (e.g., Rottoli and Castiglioni, 2011; Reed et al., 2019; Vaz et al., 2021; Bouby et al., 2022; Marzano, 2022; Bianco et al., 2023). However, this was not the case with Calçada do Lavra. In fact, the

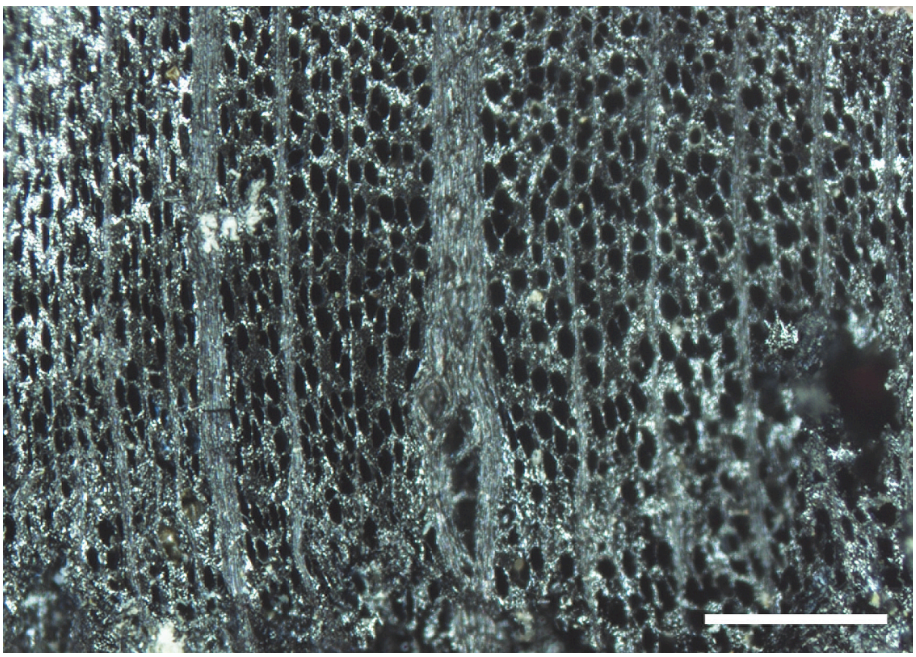


Fig. 6. Transversal section of a *Fagus sylvatica* fragment. Scale: 500 μm.

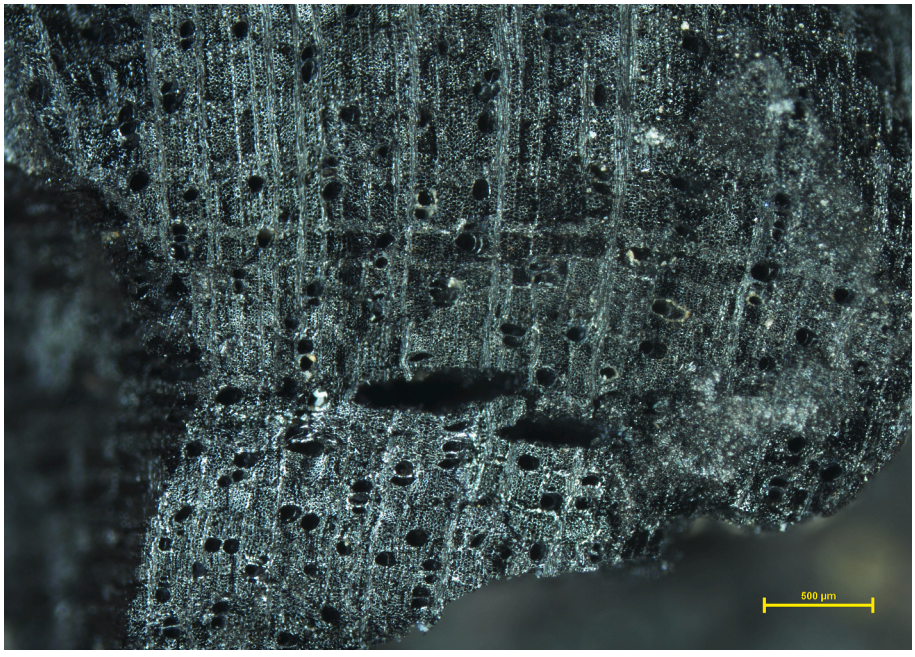


Fig. 7. Transversal section of a *Ficus carica* fragment. Scale: 500 μm.

fruits identified here (namely grape, fig, and myrtle) were found in small quantities in fewer than one-third of the analysed contexts (10 out of 35). Additionally, they were rarely discovered together, and most often only one type of fruit was recovered (see Table 5 in Supplementary Material). In the case of figs, seeds were found alongside wood from this species in two contexts; therefore, it is impossible to rule out that they were incorporated accidentally into the pyre with the fuel on some occasions. Furthermore, all these fruits could have been cultivated or gathered from the wild, as they are native to the region. Considering that the cultivation of figs and grapes was likely widespread throughout the first millennium BCE in many parts of the Iberian Peninsula, particularly in Mediterranean areas (Pérez-Jordà et al., 2021a,b), both were frequently collected in Roman funerary contexts within Iberia and other parts of the Empire (e.g. Bianco et al., 2023; Rottoli and Castiglioni, 2011; Reed et al., 2019). As a result, the remains recovered in this study may correspond to crops and plant offerings.

The most distinctive feature of the carpological assemblage recovered from Calçada do Lavra, compared with other Iberian cremation contexts, is the presence of *Myrtus communis*. Unlike grapes and figs, myrtle fruits and seeds have not previously been found in Roman cremation contexts, although they have been uncovered in other rites and at sites with diverse characteristics (e.g. Lanciani, 1892; Hamdy, 2007; Alonso et al., 2016; Pérez-Jordà et al., 2017; Peña-Chocarro et al., 2019).



Fig. 8. Offerings associated with the cremations. Legend: (1) game pieces in glass found at Cremation 21; (2) bronze case found at Cremation 18, (3) two dices made of bone found at Cremation 21; (4) set of bronze instruments possibly related to medicine practice found at Cremation 18 (Rebelo et al., 2020).

Such is the case of Pompeii, where myrtle also appears in a ritual context, albeit within a domestic sphere (Robinson, 2002). Therefore, beyond the occurrence of myrtle seeds in five cremation contexts, the discovery of four berries (Fig. 9) in Cremation 33 is particularly significant. In the absence of myrtle charcoal, this find appears to be connected to ritual significance or the symbolic meaning of the plant, often associated in the Roman world with beauty and youthfulness, as well as with the cults of Venus and Persephone, reflecting its dual connection to love, beauty and eroticism, as well as to death and funerary ritual (Rovira and Chabal, 2008). Myrtle furthermore played an important ceremonial role in the ancient world, being used in crowns awarded to Olympic victors and in ovations (Dafni, 2016). The fruits and seeds may have been deposited individually as offerings or introduced as part of fertile branches bearing berries and flowers, perhaps incorporated into garlands, wreaths, or other vegetal arrangements that were eventually employed during the funerary ceremonies.

In contrast, other plants found in these contexts appear to have lacked ritual significance, as might have been the case with the diverse wild taxa found in the *ustrinum* (see Table 5 in Supplementary Material). In fact, macroremains of ruderal taxa and potential weeds could have been used simply as kindling or as part of the local vegetation that was burned, as reported in other studies (e.g., Kreuz, 2000; Bouby and Marinval, 2004; Preiss et al., 2005; Cooremans, 2008; Rottoli and Castiglioni, 2011; Reed et al., 2019). Subsequently, the transfer of cremation remains from the *ustrinum* to secondary locations might have included the macroremains mentioned above, thus explaining the significant presence of wild taxa across different contexts. Consequently, the ritual or symbolic significance of such plants cannot be definitively confirmed nor entirely dismissed.

Finally, interpreting the presence of *Brassica/Sinapis* and Beta sp. macroremains is more complicated, as they can originate from either wild or cultivated species. The former are found at other Roman sites in the region, such as Alcáçova de Santarém (Tereso et al., 2025), while the remains of *Beta* sp. discovered in Calçada do Lavra are, so far, the first ever found in western Iberia (Tereso et al., 2024). As such, a definitive conclusion cannot be reached at the moment.

6. Conclusion

This archaeobotanical study of the cremation contexts at Calçada do Lavra is the first to be carried out at archaeological sites associated with the Northwest Necropolis of *Olisipo*. It uncovers aspects of the funerary practices in this area, from the selection and gathering of wood for constructing funeral pyres to the ritual offerings of plant remains during the *silicernium*.

Firstly, it was found that most of the fuel used in the pyres originated from species that could be found in forests in the region, such as pine, ash, and holm oak forests, consistent with a trend observed at other cremation sites in Iberia (Vaz et al., 2021). These forests were already under considerable human pressure and, as a result, were no longer very extensive. Either they were still sufficient to supply the city with wood, or the catchment area had expanded, taking advantage of the city's location, since *Olisipo* was a port city with strong river and maritime connections.

Conversely, wood from trees that should have been cultivated or managed for their fruit, primarily fig trees, was also used. The loss of large fig trees or branches may be justified by their potential symbolic value. Other cases remain less clear. For instance, the presence of olive wood might result from the exploitation of wild groves.

As such, the eventual symbolic value of some of the fuel used in the cremations has not been proven but is considered likely. This is aligned with other cremation sites across Europe (e.g. Figueiral et al., 2010; Hristova, 2015; Martín-Seijo and Vila, 2019; Vaz et al., 2021; Bianco et al., 2023).

Other elements of the assemblage document offerings, some of which may have held ritual significance. The recovery of beech wood in the busta of high-ranking individuals suggests the presence of objects made from exotic wood. However, plant offerings are primarily identified

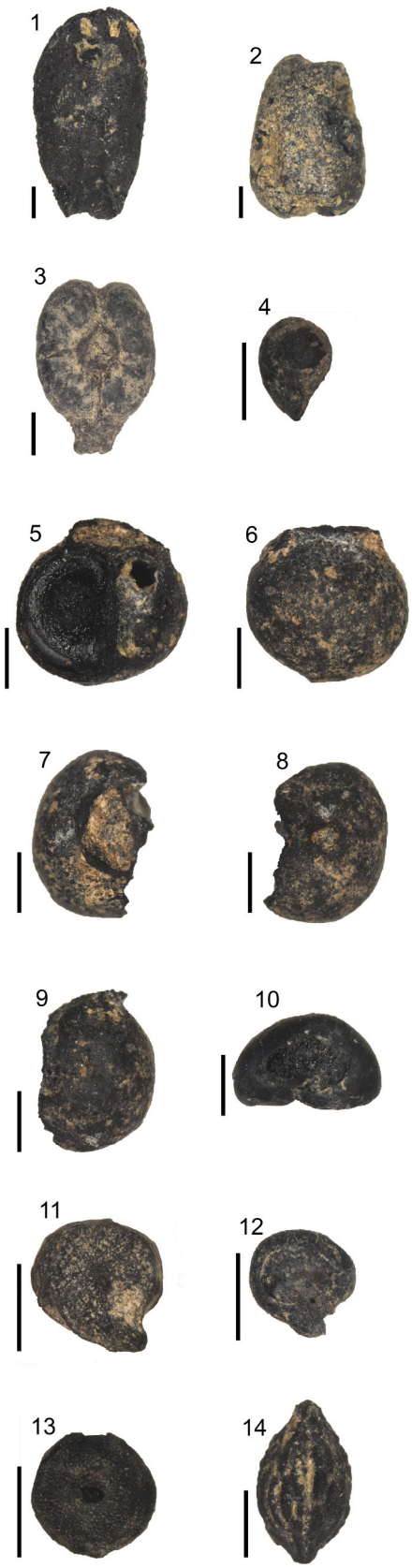


Fig. 9. Part of the carpology assemblage identified in Calçada do Lavra. Legend: naked barley grain (1); naked wheat grain (2); grape pip (3); fig achene (4); myrtle fruit (5, 7, 8, 9) and seed (10); *Beta* sp. fruit (11) and seed (12); *Brassica/Sinapis* seed (13); aneixa silicle (14). 1 mm scale.

through the seeds and fruits found. These are likely to indicate food offerings or the remains of the funeral banquet, reflecting a common practice in the Roman world that has also been observed at other cremation sites in Iberia and elsewhere in the Empire.

Ultimately, distinguishing between functional and symbolic criteria for the use of firewood and the deposition of other plant material is challenging. This distinction may be overly simplistic, as we do not know if it made sense to those performing the ritual. Nevertheless, the presence of pine, ash, and oak wood, alongside fragrant species such as the fig tree and myrtle, and possibly others, suggests that the rites involved a range of elements to ensure the successful cremation of the body while engaging the participants' senses.

CRediT authorship contribution statement

Sousa Catarina: Writing – review & editing, Writing – original draft, Investigation. **Seabra Luís:** Writing – review & editing, Writing – original draft, Investigation. **Oliveira Cláudia:** Writing – review & editing, Writing – original draft. **Tereso João:** Writing – review & editing, Writing – original draft. **Rebelo Paulo:** Investigation. **Peça Pedro:** Investigation. **Bolila Catarina:** Investigation. **Ferreira Daniela:** Investigation. **Vaz Filipe:** Writing – review & editing, Writing – original draft, Supervision.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jasrep.2026.105844.

Data availability

All data is made available in the article

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