ESTUDOS DO QUATERNÁRIO / QUATERNARY STUDIES
Nº 24, APEQ, 2024, pp. 10-23 | https://doi.org/10.30893/eq.v0i24.219

Received: January 30th , 2024; Accepted: July 2nd , 2024

OVER THE CENTURIES: LONG-TERM CROP SELECTION AND DIVERSITY AT FREIXO/TONGOBRIGA (NORTHWEST IBERIA)

AO LONGO DOS SÉCULOS: DIVERSIDADE E SELEÇÃO DE CULTIVOS A LONGO PRAZO EM FREIXO/TONGOBRIGA (NOROESTE IBÉRICO)

Luís Seabra[1], Inés López-Dóriga[2], António Lima[3], María Martín Seijo[4], Rubim Almeida[5], João Pedro Tereso[6]

Abstract: Freixo/Tongobriga (Marco de Canaveses, Northwest Portugal) is an archaeological site on a vast hill near the Tâmega and Douro rivers. It was an important Roman city, well-known for its monumental buildings (e.g. Forum, Baths). Nonetheless, excavations have shown that the area was occupied for a longer time span. In this paper, archaeobotanical results from two areas will be addressed – Wall and Housing Complex I – comprising three contexts – Wall South Section, *Impluvium* house and Round hut. These encompass a wide time period ranging from the Iron Age to the Late Antiquity. Results from the fruits and seeds analyses showed an assemblage dominated by cereals. The grains of broomcorn millet (*Panicum miliaceum*), and foxtail millet (*Setaria italica*) were predominant, followed by spelt (*Triticum spelta*). Hulled barley (*Hordeum vulgare*), naked wheat (*Triticum aestivum/durum*), rye (*Secale cereale*) and oat (*Avena* sp.) were scarce. A diverse set of fruits was collected, although in small amounts. The analysis of new and previous archaeobotanical assemblages in connection with other archaeological information and several radiocarbon determinations provided crucial information about crop selection and diversity at Freixo/Tongobriga through time.

Keywords: Fruits/Seeds, Cereals, Northwest Iberia, Iron Age, Late Antiquity

Resumo: Freixo/Tongobriga (Marco de Canaveses, Noroeste de Portugal) é um sítio arqueológico localizado numa extensa colina, próxima aos rios Tâmega e Douro. Foi uma importante cidade romana, bem conhecida pelos seus edifícios monumentais (p. ex. Fórum, Termas). Não obstante, escavações demostraram que a área foi ocupada por um período de tempo mais longo. Neste artigo serão abordados os resultados arqueobotânicos de duas áreas – Muralha e Área Habitacional I -, compreendidas por três contextos – Tramo Sul da Muralha, Casa do *Impluvium*, Casa Circular. Estes abrangem um amplo período de tempo entre a Idade do Ferro e a Antiguidade Tardia. Os resultados da análise carpológica demonstraram um conjunto dominado por cereais. Os grãos de milho-miúdo (*Panicum miliaceum*) e de milho-painço (*Setaria italica*) foram predominantes, seguidos do trigo espelta (*Triticum spelta*). A cevada (*Hordeum vulgare*), o trigo de grão nu (*Triticum aestivum/durum*), o centeio (*Secale cereale*) e a aveia (*Avena* sp.) foram escassos. Foi recolhido um conjunto diverso de frutos, embora em pequenas quantidades. A análise de prévios e novos conjuntos arqueobotânicos, em conexão com outros dados arqueológicos e várias datações por radiocarbono, providenciaram informações cruciais sobre diversidade e seleção de cultivos em Freixo/Tongobriga ao longo do tempo.

Palavras-chave: Frutos e Sementes, Cereais, Noroeste Ibérico, Idade do Ferro, Antiguidade Tardia

(1) Department of Biology, Faculty of Sciences, University of Porto, Rua Campo Alegre s/n, 4169-007 Porto, Portugal. • CIBIO, Research Center In Biodiversity and Genetic Resources, InBIO Associate Laboratory, Campus de Vairão, University of Porto, 4485-661 Vairão, Portugal. • BIOPOLIS Program in Genomics, Biodiversity and Land Planning, CIBIO, Campus de Vairão, 4485-661 Vairão, Portugal. lc_pacos@hotmail.com • https://orcid.org/0000-0002-9123-8457 (Corresponding author)

(2) Wessex Archaeology, Portway House, Old Sarum Park, Salisbury SP4 6EB England. • i.lopezdoriga@wessexarch.co.uk • https://orcid.org/0000-0002-2527-3828

(3) Comissão de Coordenação e Desenvolvimento da Região Norte – Unidade de Cultura Palacete da Quinta de São Gens, Estrada da Circunvalação, nº 11846, 4460-281 Senhora da Hora, Portugal. • antonio.lima@ccdr-n.pt • https://orcid.org/0000-0002-9144-3311

(4) Instituto de Ciencias del Patrimonio (INCIPIT), Consejo Superior de Investigaciones Científicas (CSIC), Edificio Fontan, Bloque 4, Monte Gaias, s/n. 15707 Santiago de Compostela, Spain • maria.martin-seijo@incipit.csic.es • https://orcid.org/0000-0003-2924-7763

(5) Department of Biology, Faculty of Sciences, University of Porto, Rua Campo Alegre s/n, 4169-007 Porto, Portugal. • CIBIO, Research Center In Biodiversity and Genetic Resources, InBIO Associate Laboratory, Campus de Vairão, University of Porto, 4485-661 Vairão, Portugal. • BIOPOLIS Program in Genomics, Biodiversity and Land Planning, CIBIO, Campus de Vairão, 4485-661 Vairão, Portugal. • MHNC - UP - Natural History and Science Museum of the University of Porto, Campo dos Mártires da Pátria, 81, 4050-368 Porto, Portugal. • rubim.almeida@fc.up.pt • https://orcid.org/0000-0003-4959-0147

(6) CIBIO, Research Center In Biodiversity and Genetic Resources, InBIO Associate Laboratory, Campus de Vairão, University of Porto, 4485-661 Vairão, Portugal. • BIOPOLIS Program in Genomics, Biodiversity and Land Planning, CIBIO, Campus de Vairão, 4485-661 Vairão, Portugal. • MHNC - UP - Natural History and Science Museum of the University of Porto, Campo dos Mártires da Pátria, 81, 4050-368 Porto, Portugal. • Centre of Interdisciplinary Studies of Coimbra, Rua Filipe Simões nº33, 3000-186 Coimbra, Portugal. • Centre for Archaeology, UNIARQ, School of Arts and Humanities, University of Lisbon, Alameda da Universidade, 1600-214 Lisboa, Portugal. • jptereso@gmail.com • https://orcid.org/0000-0003-0871-8255

1. Introduction

Freixo/Tongobriga (Northwest of Portugal) is an archaeological site located in the village of Freixo, municipality of Marco de Canaveses, district of Porto, around 3 km east of the Tâmega river, which downstream merges into the Douro river (Fig. 1). It was implanted on a vast hill, at around 300 m a.s.l. The site is integrated within the Eurosiberian biogeographical region, namely the Galicia and North Portugal Sector, and more precisely the Porto and Low Douro district. A Mediterranean pluviseasonal oceanic bioclimate is observed, characterized by lower mesomediterranean and lower to upper humid conditions (Costa *et al.,* 1998; Rivas-Martínez *et al.,* 2011; Rivas-Martínez *et al.,* 2017; Alves & Honrado, 2021; Capelo & Aguiar, 2021).

References to Freixo/Tongobriga are widely observed in historical documentation, although these only mention general considerations such as the presence of a religious building or ancient ruins (e.g. Aguiar, 1758; Azevedo, 1845; Azevedo, 1940; David, 1947; Craesbeeck, 1992). In the late 18th century, and mainly in the 19th century, house-building and farming caused deep transformations in the archaeological area. On the other hand, those activities uncovered material and structures, grabbing the attention of pioneer researchers (e.g. Hübner, 1869; Vasconcelos, 1899-1900; Sarmento, 1901a; Sarmento, 1901b; Sarmento, 1901c; Vasconcelos, 1914; Vasconcelos, 1916; Lima, 2020a).

The archaeological interventions started in 1980 and have been recurrent since then till 2015. The Roman finds are of particular note, being identified several public and private buildings, such as the Forum, Baths or *Domus*. The presence of other typical Roman structures (Theatre, Circus, and Amphitheatre) has also been pointed out, requiring confirmation through excavation (Dias, 1997; Rocha *et al.,* 2014; Lima, 2020a; Silva, 2020). Those facilities were part of the city of *Tongobriga*, which was probably established between the late 1st century and the early 2nd century CE (e.g. Dias, 1997; Dias, 2013; Dias, 2018; Dias, 2020). It was a city with an important role at a regional level, likely a *civitas* within the *conventus Bracaraugustanus* (e.g. Dias, 1997; Dias, 2013, Dias, 2018; Dias, 2020).

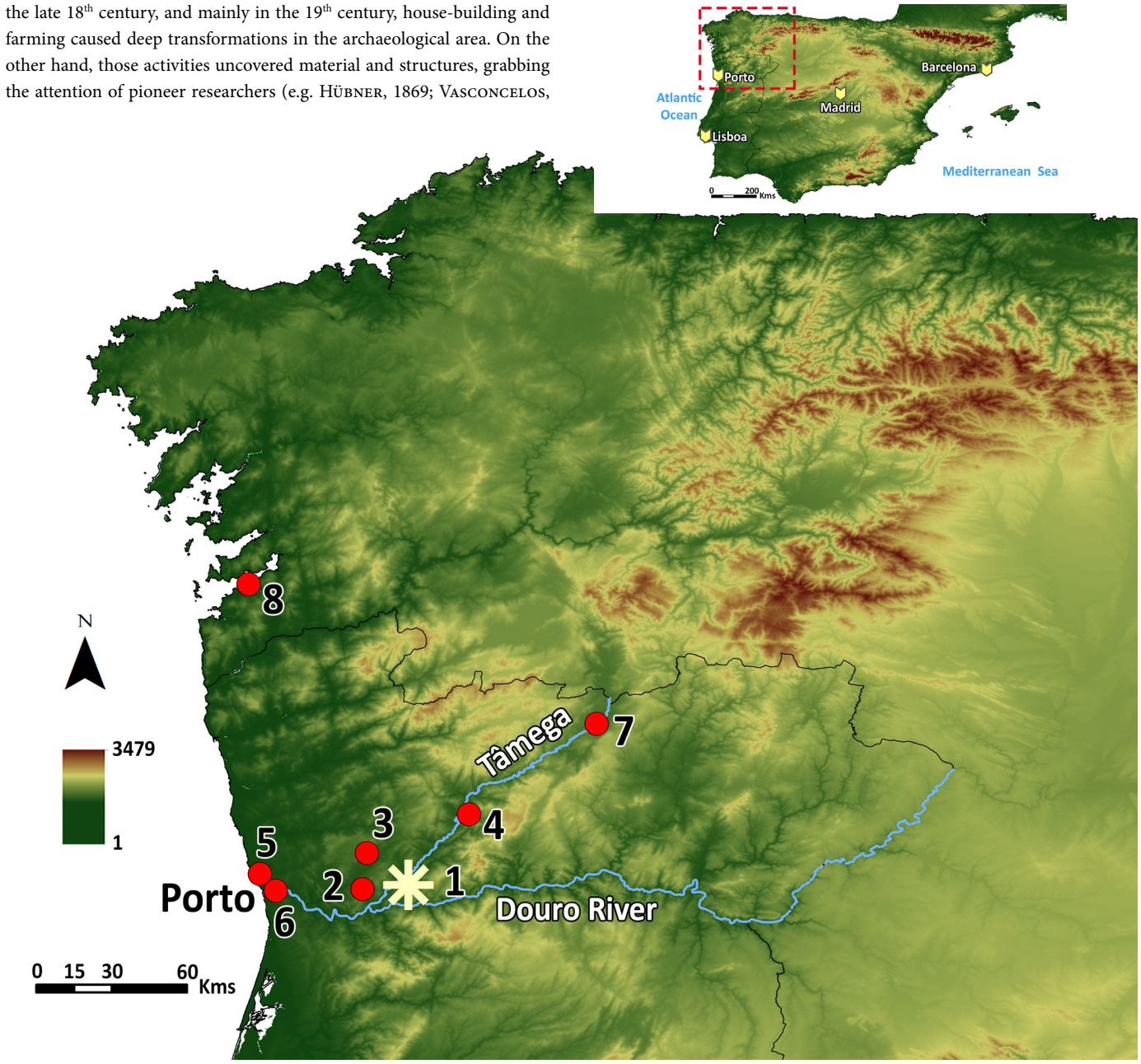

Fig. 1. Location of the sites mentioned in the article: 1 – Freixo/Tongobriga; 2 – Monte Mozinho; 3 – "Casa Romana" (Roman house) of the Castro de São Domingos; 4 – Crastoeiro; 5 – Castro de Guifões; 6 – Rei Ramiro; 7 – *Aquae Flaviae*; 8 – O Areal.

Fig. 1. Localização dos sítios mencionados no artigo: 1- Freixo/Tongobriga; 2 – Monte Mozinho; 3 – "Casa Romana" do Castro de São Domingos; 4 – Crastoeiro; 5 – Castro de Guifões; 6 – Rei Ramiro; 7 – *Aquae Flaviae*; 8 – O Areal.

The Roman structures were often built over Iron Age levels or in nearby spaces, sometimes maintaining the same function: the Roman baths were built next to an Iron Age sauna (Dias, 1997; Dias, 2020); the construction of *Domus* in the central platform followed the destruction of previous Iron Age houses, despite both types may have coexisted in an initial stage (Dias, 1997; Dias, 2020); Roman and Iron Age houses were found next to each other in a southern area. These last structures were badly preserved making difficult the comprehension of this area, still, the pattern observed was similar to the other spaces (Winkes, 2020).

Human occupation at Freixo/Tongobriga surpassed the Iron Age and Roman periods, although it became less significant. The archaeological data suggest that from Late Roman times onwards few new constructions occurred, and only minor changes were applied to roman *domus* (Dias, 1997; Lima, 2016; Lima, 2017a). Gradually, the site´s occupation focused in the central area and its surroundings, where an important building was raised somewhere between the 5th and 6th centuries CE, according to the architectural features and polychromatic mosaics observed, as well as available written documentation (Lima, 2016; Lima, 2017a). However, the old roman baths were still in use in the 6th century, probably with different purposes, eventually as a Christian temple (Lima, 2020b). The ancient roman *forum pecuarium* – a large enclosed space to store and trade goods - kept being used as an important regional market till the 16th century (Lima, 2017b).

The relevance and diversity of contexts found led to several multidisciplinary approaches, including anthropological analyses over a Late Roman necropolis (Silva & Santos, 2020; James *et al.*, 2022); considerations about the urban planning of the Roman city and its buildings (Rocha *et al.*, 2014); or proposals for the site´s requalification and the nearby landscape (Medeiros & Fernandes, 2016). Following this interdisciplinarity, recent excavations (2014-15) in three areas (Housing Complex I, Forum, and Wall), coordinated by one of the authors (A. Lima), also included sediment recovery for archaeobotanical analysis (López-Dóriga, 2020).

In the Forum, several Bronze Age pits showed a rich fruits/seeds assemblage, including evidence of storage (Tereso *et al.*, 2016; Lima *et al.*, 2020; López-Dóriga, 2020). In the remaining areas, partial analyses were already carried out (Lima *et al.*, 2020; López-Dóriga, 2020), but the study of all contexts and deposits is not complete yet. Therefore, in this approach, we will present the full fruits/seeds results in coordination with the characterization of the respective archaeological deposits. These contexts reflect more than one millennium of history from the Iron Age to Late Antiquity, being relevant to understand the agricultural decisions of past communities during such a long period.

2. Materials and Methods

2.1. Sampling and analysed contexts

Three contexts associated with two areas are included in this study: Wall (South Section), the *Impluvium* house and a Round hut (Housing Complex I) (Fig. 2). In two years of excavations (2014-2015) were collected 333 sediment samples from 51 stratigraphic units (s.u.), corresponding to 3,815 L. The samples were processed through a Siraf-type flotation machine, using a 0.25 mm mesh. The large amount and volumes of the samples, as well as time constraints, led us to carry out a selection of samples to be studied. Assuring the representativeness of the assemblage, at least one sample per s.u. was studied, corresponding to 85 samples and 995 L of sediment. Despite some variations, the number of samples analysed per s.u. often varied between one and two.

In order to better understand the chronology of those three contexts and deposits, several fruits/seeds were dated (Table 1). The radiocarbon results showed chronologies spanning from the Iron Age (earliest date is from the 5th-3rd centuries BCE) to the Late Antiquity (5th-6th centuries CE).

2.1.1. South Section - Wall

Written sources mention that Freixo/Tongobriga was walled (Aguiar, 1758; Vasconcelos, 1914). Even so, only in 2005 was discovered a southern section of the Wall (Lima *et al.*, 2020; Winkes, 2020). Its excavation was expanded in the 2014/15 campaigns (Fig. 3), allowing the comprehension of the Wall´s characteristics and phases of construction. Initially, this structure corresponded to a rudimentary construction, being reinforced in a second moment. The sloped terrain and the structural instability of the Wall led to the application of preventive measures afterward (Lima *et al.*, 2020).

Twenty-six samples (482 L) from 14 s.u. were analysed. The majority correspond to deposits accumulated next to the Wall throughout time. These deposits may relate to a habitational area located a few metres above (Housing Complex II-Fig. 2), where two badly preserved Iron Age

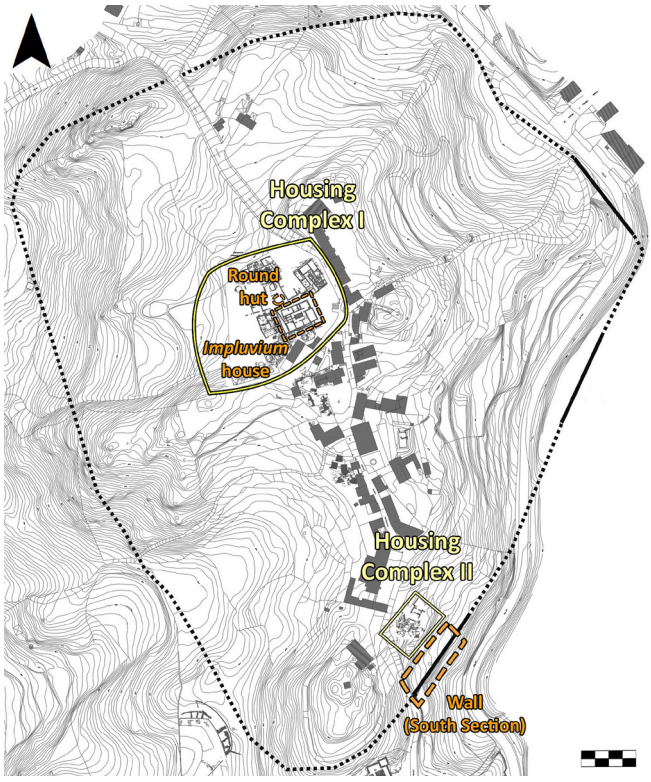

Fig. 2. Location of the habitational areas (yellow) and studied contexts (orange). Adapted from Lima *et al.*, 2020 (Proposal of the Wall's perimeter by António Lima, drawn by António Freitas). Scale 400 meters.

Fig. 2. Localização das áreas habitacionais (amarelo) e dos contextos estudados (laranja). Adaptado de Lima *et al.*, 2020 (Perímetro da muralha proposto por António Lima, desenhado por António Freitas). Escala 400 metros.

houses have been recorded (Winkes, 2020). The similarity between the material culture of both contexts and the steepness of the terrain suggest that remains found next to the Wall are, at least partially, the result of remobilizations from the upper area where the habitational area is (Lima *et al.*, 2020). Sediment between the wall´s stones was also recovered and associated with the two construction phases observed whenever possible. Other structures were badly preserved and difficult to interpret (Lima *et al.*, 2020; López-Dóriga, 2020).

The radiocarbon dates obtained in the Wall context revealed results covering the last five centuries before the turn of the Era, i.e. most of the Iron Age until the first contacts with the Romans. Still, the complex stratigraphy, with the abovementioned secondary or tertiary context, does not allow a detailed phasing. The charred plant remains essentially came from deposits integrating sediment from different places and moments. The long time span reflected in the radiocarbon dates and the analysis of ceramic material also attest this idea (Lima *et al.*, 2020; López-Dóriga, 2020).

2.1.2. Housing Complex I

Two habitational structures from Housing Complex I (Fig. 2) will be examined: an Iron Age Round hut (Fig. 4), and the Late Antique *Impluvium* house (Fig. 5).

The Iron Age Round hut from the Housing Complex I was partially intervened in previous campaigns (Dias, 1997), but no archaeobotanical sampling was carried out. Only the excavation of its eastern limits (around 4 m^2), which occurred in 2015, included a specialist in archaeobotany. A diversity of deposits was identified, either associated or not with structures (e.g. pit, posthole, deposits related to abandonment/destruction or fire events). However, not only the results from a radiocarbon date and the chronology of the artifacts recovered do not always match, but also, the first levels showed evidence of perturbations, this time by a modern pit [4]. Deposits with Iron Age chronology (s.u. [34], [35], [36], [37]) correspond to parts of combustion structure [38] and a masonry Wall [13], and a radiocarbon date obtained from a fire layer [11] points out to a period within the 4th-2nd centuries BCE, thus confirming this chronology (Table 1). Still, Late Roman material was predominant in most layers, suggesting a later use of the area, but demanding caution in the interpretation of this assemblage (see above discussion). Fruits/seeds from 41 sediment samples (329 L) were analysed, coming from 28 s.u., most of them from inside the house.

The *Impluvium* house has approximately 325 m^2 and was raised in the late 1st century CE-early 2nd century CE, in the initial moments of the Roman city (Dias, 1997; Rocha *et al.*, 2014). A stone drainage system was found in the lower levels of the house with two layers associated, namely a preparation level [12] and the deposit [11] that filled the structure. A radiocarbon date on foxtail millet grains from the preparation level provided a Late Iron Age chronology (Table 1), i.e. slightly earlier than the house itself, which suggests the construction of this structure involved the remobilization of sediment from previous occupations. Still, the analysed deposits derive mostly from the Late Antiquity, and radiocarbon dates point to two consecutive phases within this period, one from the 3rd-5th centuries CE and the other from the 5th-6th centuries CE (Table 1). Eighteen samples (184 L) from 9 s.u. were studied. These include a fire level (s.u. 3), deposits associated to the abandonment of the structure, and a wooden floor (s.u. 8 and 9).

Table 1. Radiocarbon dates obtained at Freixo/Tongobriga. Calibration OxCal 4.4.4 software (Bronk Ramsey, 2001), IntCal 20 calibration curve (Reimer *et al.*, 2020). The calibrated ages were rounded to the nearest five (uncertainties below 25) and 10 (uncertainties above 25) years, following Bayliss & Marshall (2022).

Tabela 1. Datações por radiocarbono obtidas em Freixo/Tongobriga. Calibração através do software OxCal 4.4.4 (Bronk Ramsey, 2001), curva de calibração IntCal 20 (Reimer *et al.*, 2020). As datas calibradas foram arredondadas para os cinco (incertezas abaixo de 25) e 10 (incertezas acima de 25) anos mais próximos, seguindo Bayliss & Marshall (2022).

Area	Context	S.U.	Material	Lab. Ref.	14C age (yr BP)	Calibrated age BCE-CE (68.3%)	Calibrated age BCE-CE (95.4%)	References
South Section	Wall	4.1	*Secale cereale* (grain)	D-AMS 042655	2062 ± 22	105-5 BCE	155 BCE-10 CE	Seabra *et al.*, 2023b
		5	*Panicum miliaceum* (grains)	D-AMS 011938	2314 ± 34	410-360 BCE	470-200 BCE	López-Dóriga, 2020
		6	*Triticum spelta* (grain)	D-AMS 009827	2102 ± 27	160-50 BCE	200-40 BCE	
		6	*Setaria italica* (grains)	D-AMS 011939	2141 ± 43	350-50 BCE	360-40 BCE	
		M4	*Triticum spelta* (grain)	D-AMS 011940	2237 ± 29	380-200 BCE	390-200 BCE	
Housing Complex I	Round hut	11	*Secale cereale* (grain)	D-AMS 047814	2158 ± 21	350-160 BCE	355-105 BCE	Seabra *et al.*, 2023b
	Impluvium house	3	*Castanea sativa* (fruit)	D-AMS 009828	1560 ± 30	430-570 CE	420-580 CE	López-Dóriga, 2020
		8	*Secale cereale* (grain)	D-AMS 009829	1692 ± 27	260-410 CE	250-420 CE	
		12	*Setaria italica* (grains)	D-AMS 009830	2083 ± 26	150-40 BCE	180 BCE-10 CE	

Fig. 3. Excavation of [5], next to the Iron Age Wall. Scale 50 cm.
Fig. 3. Escavação da [5], junto à muralha da Idade do Ferro. Escala 50 cm.

Fig. 4. Round hut (blue) and excavated area in 2015 (orange). Scale 1m.
Fig. 4. Casa circular (azul) e área escavada em 2015 (laranja). Escala 1m.

2.2. Laboratory work

Light fractions were sorted under a stereoscopic microscope by two authors (Inés López-Dóriga and Luís Seabra) in the facilities of the Faculty of Sciences of the University of Porto and the Archaeological Station of Freixo. Specialized bibliography guided the taxonomic identification (e.g. Beijerinck, 1976; Castroviejo, 1986-2012; Hillman *et al.*, 1996; Buxó, 1997; Jacomet, 2006; Nesbitt, 2006; Neef *et al.*, 2012; Zohary *et al.*, 2012). Whenever necessary, fruits/seeds were compared with modern material from the reference collections of the University Porto Herbarium (PO) at the Natural History and Science Museum of the University of Porto (MHNC-UP) and from CIBIO.

Each sample was separated through a column of sieves (2 mm, 1 mm, 0.5 mm and 0.25 meshes). The content of 2 mm meshes was always sorted, with subsampling restricted to the remaining meshes. Subsampling was carried out through a riffle box, and mainly to 0.5 mm meshes from the Wall and Round hut contexts. The majority of the 0.25 meshes was not studied. Each sample often displayed few fruits/seeds, normally below 10 and never exceeding 20 units. For this reason, results from subsamples were not extrapolated to estimate the number of remains present in the samples.

Entire fruits/seeds and fragments with scutella or hila were counted as units. Longitudinal fragments (cereals) and cotyledons (legumes) were counted as one unit when two remains were recovered. Regarding chaff, rachis segments and nodes, as well as glume and spikelet bases were considered units. Hulled grains or with husks still attached were referred separately. Units and results per context are expressed in Table 2.

Taxonomic designations follow the checklist for Portuguese flora (Sequeira *et al.*, 2011) and, for cultivated plants, Zohary *et al.* (2012). Oat grains were identified at the genus level (*Avena* sp.) since they were always present without floret bases, being those crucial for a detailed diagnosis (e.g. Ruas & Pradat, 2001; Jacomet, 2006). Naked wheat grains were designated as *Triticum aestivum/durum*, a morphological type that includes *Triticum aestivum*, *Triticum durum*, and *Triticum turgidum* grains (Buxó, 1997). Other identifications with less detail (e.g. tribe, family, subfamily) were often applied, mainly due to the poor preservation of the plant remains.

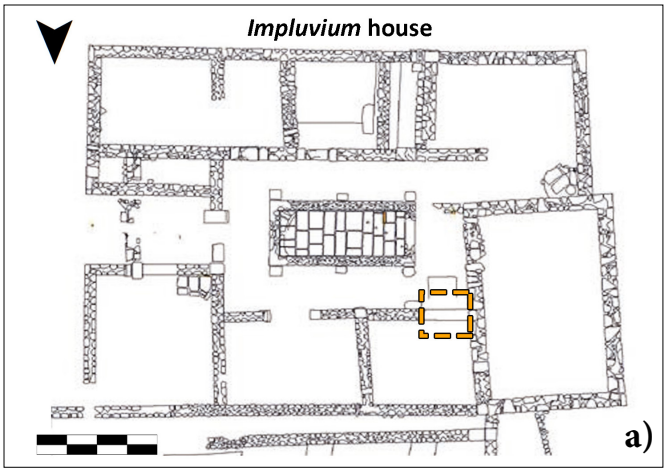

Fig. 5. Above: **a)** *Impluvium* house (adapted from Rocha *et al.*, 2014) and excavated area (orange). Scale 4 m. Below: **b)** Drainage system covered by stones [10]; **c)** Stratigraphic section (after the excavation). Scale 0.50 cm.

Fig. 5. Acima: **a)** Casa do *Impluvium* (adaptado de Rocha *et al.*, 2014) e área escavada (laranja). Escala 4 m. Abaixo: **b)** Sistema de drenagem coberto por pedras [10]; **c)** Perfil estratigráfico (após escavação). Escala 0,50 cm.

3. Fruits/Seeds results

3.1. Overall results

The results show a substantial assemblage of fruits and seeds (n=2,713), mostly composed of cereal remains (79%) (Table 2). Millet grains are predominant (n=1,549), including broomcorn millet (*Panicum miliaceum*) (n=484), foxtail millet (*Setaria italica*) (n=324), and badly preserved grains identified as Panicoideae (n=737). These are probably either from *P. miliaceum* or *S. italica*, since no other wild or cultivated millet has been recorded. Spelt (*Triticum spelta*) grains are significant (n=145) and other cereal grains are sporadic, namely of hulled barley (*Hordeum vulgare*), rye (*Secale cereale*), naked wheat (*Triticum aestivum/durum*), and oat (*Avena* sp.).

Chaff remains are fewer. Most of them correspond to glume bases of hulled wheats, namely *Triticum* (n=148), and spelt (n=138). A few whole spikelets of those cereals were also collected. Rachises of hulled barley, spelt, naked wheat, and rye were rare. Some millet grains are fully hulled or with husks still attached.

A small set of wild pulses (5%) was collected, including Genisteae, *Ornithopus* sp., Fabaceae – *Trifolium* type, among others. *Vicia/Lathyrus* seeds are recurrent, but although it is unclear if they corresponded to domesticated or wild remains, the latter is more likely considering the small size of the seeds. A diverse set of fruits remains was recovered. The most frequent are pips and pedicels of grape (*Vitis vinifera*), pyrenes of blackberry/raspberry (*Rubus* sp.) and fig (*Ficus carica*), whereas other fruits were more sporadic, such as acorn remains (*Quercus* sp.), chestnut fruits (*Castanea sativa*) or pyrenes of elderberry (*Sambucus* sp.). A bract of pine (*Pinus* sp.) was also found.

The other plant remains are essentially grasses, such as *Poa* sp. or *Lolium/Festuca,* and other wild remains. They were often scarce, even so, some diversity was observed. For instance, significant amounts of *Solanum* seeds, *Rumex* sp. achenes, or *Malva* sp. seeds were collected. These remains may correspond to weeds or ruderal plants, since they have a wide ecological range (Castroviejo, 1986-2010; Aguiar, 2000).

3.2. Results per Context

The three contexts (Wall, *Impluvium* house and Round hut) displayed fruits/seeds assemblages with different dimensions and characteristics (Table 2 and Fig. 6):

1. Most of the fruits/seeds collected at Freixo/Tongobriga came from the Iron Age levels of the Wall area (67%), but it should be mentioned this was the area from which more sediment was analysed (482 L). This context revealed most of the cereal remains found (1,646 out of 2,136). Millet grains were preponderant, mainly broomcorn millet. Grains and chaff of spelt were found in significant numbers, whereas hulled barley, naked wheat, rye, and oat were scarce. It is noteworthy that all acorns, both cotyledons and cupules, were found here. Other wild remains were rare.

2. The Round hut is the second context with more fruits/seeds (n=657), most coming from the Late Roman levels, and only a few from the Iron Age (n=49). Although remains of fruits and seeds were less abundant than in the Wall area, a smaller volume of sediment was studied (329 L). The cereal remains were again dominant, although less obviously. Millet grains identified at the tribe level (Panicoideae) and broomcorn millet were prevailing, followed by foxtail millet. The grains and chaff of spelt were reduced, but the significant record of glume bases of *Triticum* suggests that hulled wheats were also relevant in the Round hut. Hulled barley and naked wheat grains were rare. This cereal record is somehow identical to that from the Wall area (see Discussion). In the same way, rye and oat were also found in few numbers. On other hand, some differences were observed concerning fruits and other plant remains. In the Round hut were recovered substantial concentrations of fig seeds, pips and pedicels of grape, as well as a few blackberry/raspberry and elderberry pyrenes, and a pine bract. Other wild remains were more abundant and diverse here than in any other area.

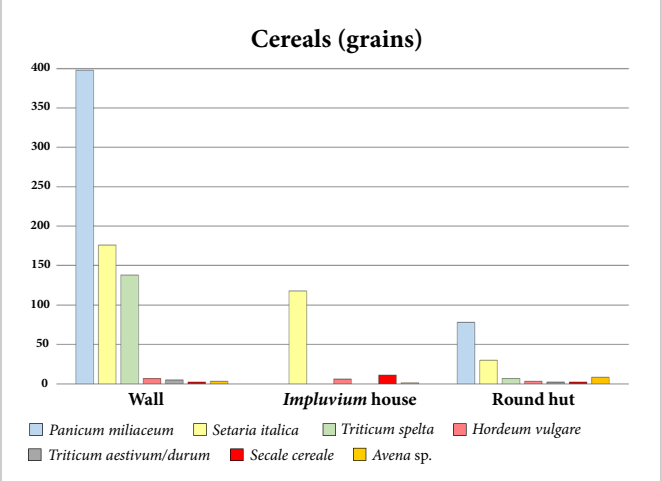

Fig. 6. Main cereal grains in the Wall, *Impluvium* house and Round hut, at Freixo/Tongobriga.

Fig. 6. Principais grãos de cereais presentes na Muralha, Casa do *Impluvium* e Casa Circular em Freixo/Tongobriga.

3. The *Impluvium* house provided few fruits/seeds (n=245), but the volume of sediment analysed was the lowest (184 L). Foxtail millet grains were dominant. Oat, hulled barley and rye grains were recovered in small amounts. No broomcorn millet grain was clearly identified. It was identified a single chaff remain, namely a *Triticum* glume base. The compartment studied revealed the only chestnut fruits of the site. Blackberry/raspberry pyrenes and a grape pip were other fruits recovered.

4. Discussion

4.1. Archaeological contexts, plant remains, and radiocarbon dates: how they complement each other

Decades of excavations at Freixo/Tongobriga revealed a long-term occupation that started at least in the Bronze Age and lasted until today. Several Iron Age contexts were heavily disturbed during Roman times, causing difficulties in the interpretation of this occupation. Beyond that, recent construction and agricultural activities caused deep transformations in the whole archaeological site (Dias, 1997; Lima *et al.*, 2020).

The Wall area is the context with more robust Iron Age data. Essentially, deposits correspond to sediment accumulated next to or within the Wall through time. As such, fruits/seeds remains likely derive from secondary or tertiary refuse deposits (*apud* Schiffer, 1996; La Motta and Schiffer, 1999), or even from natural depositions resulting from different post-depositional processes. The interpretation of such contexts may be challenging, and their chronology may raise some doubts. They are more likely product from long-term dynamics, being less prone to the contingencies of primary contexts (e.g. Fuller *et al.*, 2014; Vaz *et al.*, 2016b). Nonetheless, and regardless of the varied radiocarbon results, all evidence points to an Iron Age chronology (Table 1).

Other Iron Age plant remains were recovered in the Round hut from Housing Complex I but these were rare. Most remains from this complex date to the Late Roman period. There were fewer plant remains, but cereals, and more particularly millets were predominant in both contexts (Table 2). Hulled wheats were also relevant in the two contexts. Grains and chaff of spelt were in higher amounts in the Wall, whereas glume bases of *Triticum* sp. were more significant in the Round hut. Since spelt was the only hulled wheat clearly identified at Freixo/Tongobriga, it is possible that those remains also correspond to spelt. The main difference in comparison with the Wall area concerns the higher number and diversity of wild remains and fruits in the Round hut, particularly the record of plants with high economic value in Roman times, such as fig or grape. The archaeological and archaeobotanical records demand caution regarding the chronology of the fruits/seeds remains from this house. Still, and considering the result of the radiocarbon date obtained (4th-2nd centuries BCE) in an allegedly Late Roman level [11], and some of the similarities observed in the fruits/seeds record, we cannot exclude an Iron Age chronology for several of those plant remains. Further radiocarbon dates may eventually clarify this matter in the future.

A Pit (s.u. [28]) was identified in the Round hut. It showed coated walls and plant remains were found inside (s.u. [29]), namely grains of broomcorn millet and spelt, as well as some chaff of hulled wheats (*Triticum* sp. and *Triticum spelta*) and rachises nodes of naked wheat. However, these remains were present in small amounts and the archaeological data did not point to a primary storage context.

Most of the deposits studied in the *Impluvium* house provided a Late Antique chronology. A radiocarbon date from a lower level (s.u. [12]) showed a Late Iron Age chronology, previous to the house construction, and Iron Age evidence is widespread in Housing Complex I, including near the *Impluvium* house. Thus, the area is likely disturbed and at least the levels related to the drainage system may contain archaeological and archaeobotanical material from more than one period. The fruits/seeds results do not clarify this matter. A small assemblage was collected, being foxtail millet predominant in layers with different chronologies. The only exception concerns the absence of rye in layer [12], but this consideration should not be overemphasised due to the low number of fruits/seeds remains.

As observed, the analysed contexts require a careful approach. Most of the fruits and seeds recovered at Freixo/Tongobriga came from secondary and tertiary deposits of difficult interpretation and chronological detail. Nonetheless, overall data pointed out an Iron Age chronology for the macroremains recovered in the Wall area, and some of those from the Round hut, while the chronology of the fruits/seeds collected in the Late Roman levels is dubious and cannot be properly established without more direct radiocarbon dating. The plant remains recovered in the *Impluvium* house likely date to Late Antiquity, except those from the layer [12], which may include fruits/seeds from different periods.

4.2. Crops

The archaeobotanical assemblage with the help of archaeological data and radiocarbon dates, provided relevant information regarding crop choices for two particular periods: the Iron Age and the Late Antiquity. The lack of evidence from High Imperial times prevents considerations about this period at Freixo/Tongobriga.

The fruits/seeds results displayed a diversity of crops, mainly cereals. In number, millets (broomcorn and foxtail millets) were dominant, but it should be taken into account the relatively small dimension of the assemblage. Clear domesticated millet remains were not identified in the Middle Bronze pits of Freixo/Tongobriga (Tereso *et al.*, 2016; López-Dóriga, 2020). It seems that millets only gained importance in Iberia in the Late Bronze Age and its relevance further increased in the Iron Age (Tereso *et al.*, 2016; González-Rabanal *et al.*, 2022). Broomcorn millet was a major crop during this last period (e.g. Figueiral, 2008; Rey Castiñeira *et al.*, 2011; Tereso, 2012; Tereso *et al.*, 2013b; Figueiral *et al.*, 2017; Martín-Seijo *et al.*, 2019; Teira-Brión, 2019). Broomcorn and foxtail millets were also common in other Late Antique contexts in Iberia (Tereso *et al.*, 2013a; Peña-Chocarro *et al.*, 2019; Teira-Brión, 2019; Seabra *et al.*, 2022).

The record of spelt was significant in Iron Age and supposedly Late Roman levels. Spelt is another staple Iron Age crop, being often dominant in northwestern sites, and the Tâmega valley is not an exception, as observed at the site of Crastoeiro (Mondim de Basto) (Tereso, 2012; Tereso *et al.*, 2013b; Seabra *et al.*, 2018; Teira-Brión, 2019). On the contrary, in Late Roman contexts, spelt is almost residual, and the actual age of the remains found in these deposits of the Round hut must be questioned. Other hulled wheats, einkorn and emmer (*Triticum monococcum* and *Triticum dicoccum*), were recovered at Freixo/Tongobriga, but only in the Middle Bronze Age pits (Tereso *et al.*, 2016; López-Dóriga, 2020), suggesting that they lost relevance after this period.

Naked wheat and hulled barley were frequently recorded in the Iron Age levels at Freixo/Tongobriga but usually in small amounts. Naked barley (*Hordeum vulgare* var. *nudum*) is absent in the Iron Age levels, as in most sites from Northwest Iberia. This contrasts with data from the earlier Middle Bronze Age pits of Freixo/Tongobriga, where naked wheat and naked barley were the most abundant cereals (Tereso *et al.*, 2016; López-Dóriga, 2020), reflecting a change in crop selection.

The interpretation of oat and rye is more complex. Only a few oat grains were collected from the three contexts, and without floret bases it is impossible to distinguish between domesticated and wild remains (e.g. Ruas & Pradat, 2001; Jacomet, 2006). The cultivation of oat likely started during the Iron Age in northwest Iberia (Tereso, 2012; Tereso *et al.*, 2013b), but at Freixo/Tongobriga, it was not possible to confirm or dismiss this idea.

A few rye grains were collected from the three analysed contexts and dated. A grain from the Wall showed a Late Iron Age/Early Roman age, sometime between the 2nd century BCE to the early 1st century CE (Table 1). An even older result from the 4th century BCE to the late 2nd century BCE was obtained on a grain from the Round hut. The presence of rye in two different moments but continuous in time, suggests it was frequent in the surrounding fields of Freixo/Tongobriga. These sparse early results are similar to others in Northwest Iberia, including nearby sites, such as Crastoeiro and "Casa Romana" (Roman house) of the Castro de São Domingos (Lousada), in the Sousa valley, and suggest that all rye remains may correspond to weeds in other cereal fields, probably spelt (Seabra *et al.*, 2023b).

On the other hand, a rye grain from the *Impluvium* house provided a Late Roman chronology (3rd century – early 5th century CE). At that moment, rye was already a staple crop, according to evidence from nearby sites, namely Monte Mozinho (Penafiel) in the right margin of the Tâmega river, and other Iberian sites as well (Alonso, 2005; Colominas *et al.*, 2019; Peña-Chocarro *et al.*, 2019; Seabra *et al.*, 2023b). Still, only a small number of grains was recovered, being difficult to describe to evaluate the role of rye as a crop in the agricultural systems at Freixo/Tongobriga.

A varied set of fruits was observed. The acorns collected are wild remains, whereas regarding blackberry/raspberry, grape and fig may correspond to wild or domesticated plants. Grape is an important economic fruit and frequent in the archaeobotanical record but remains are few at Freixo/Tongobriga and almost all came from the Round hut, which demands a careful look in terms of chronology. Only one pip was identified in the *Impluvium* house. Identical considerations could be pointed to the small number of fig remains recovered, also from the Round hut. Fig is more uncommon in the fruits/seeds record of northwest Iberia, and besides Freixo/Tongobriga, it was recovered in the Late Roman site of O Areal (Vigo) (Teira-Brión, 2010; Teira-Brión, 2019; Teira-Brión, 2022), and more recently in the Iron Age levels of Rei Ramiro (Vila Nova de Gaia) (Seabra *et al.*, 2023a).

Considering the large dimension of the chestnut fruits found, the archaeological context where they were found (*Impluvium* house) and chronology revealed by one of them (5th-6th centuries CE), these fruits likely correspond to domesticated remains. There is an increasing frequency of chestnut in the fruits/seeds record from Late Roman times onwards, in NW Iberia, being found in several other sites in northern Portugal such as Monte Mozinho, Castro de Guifões (Matosinhos), and *Aquae Flaviae* (Chaves), as well as in the Galician site of O Areal, suggesting its expansion occurred during this period of time (Teira-Brión, 2010; Vaz *et al.,* 2016a; Vaz *et al.*, 2017; Teira-Brión, 2019; Seabra *et al.*, 2020; Teira-Brión, 2022).

5. Final Remarks

Freixo/Tongobriga had a long-lasting human occupation and a crucial role during several historical periods at a regional and perhaps supraregional scale, benefiting from its strategic location between important river and land routes. The economic relevance of the navigability of the Douro and Tâmega rivers, nearby Freixo/Tongobriga, has already been recognized since Roman times (Lima & Menchón I Bes, 2018). It is also known the importance of a Roman road that passed in *Tongobriga*, and eventually connected two provincial capitals (*Bracara Augusta* and *Emerita Augusta)*. Its relevance is also demonstrated through the archaeobotanical record, being observed a diverse assemblage, resulting from the exploitation of different taxa through time.

Most of the crops found correspond to cereals. The millets, namely broomcorn millet and foxtail millet, followed by spelt, would have been the most relevant crops in the Iron Age, whereas hulled barley and naked wheat were secondary. The status (domesticated/wild) of oat is uncertain. Comparison with the results from the Middle Bronze Age pits showed that other crops were preferred at that time. Naked wheat and naked barley were likely more relevant, different hulled wheats (emmer and einkorn) were cultivated, and millets were not yet documented.

Given the doubts pointed for the Round hut, and the small fruits/seeds assemblage collected in the *Impluvium* house, it was not easy to perceive concrete changes in crop choices from the Iron Age to the Late Antiquity.

The above-mentioned Iron Age crops appear in the Round hut and in presumed Roman levels, but several indicators suggest that the age of the fruits/seeds from these contexts is problematic. More radiocarbon dates are necessary to understand if broomcorn millet, naked and hulled wheats were relevant crops after the Iron Age. Foxtail millet is the only crop recurrent in all contexts and periods at Freixo/Tongobriga. Hulled barley was barely found in Iron Age and Late Antique levels.

Rye also appears in the three contexts but likely in different forms, as a weed (in the Iron Age) and a crop, at a later phase of the Roman Empire (Seabra *et al.*, 2023b) and since then it became increasingly relevant in the agricultural strategies of several Iberian regions, including the Northwest, but also in other European areas (e.g. Behre, 1992; McCormick, 2013; Bakels, 2014; Squatriti, 2019).

Despite some difficulties in tracing crop choices at Freixo/Tongobriga, it was observed that past human communities selected a diversity of crops over a broad period. The information obtained did not allow secure considerations about the causes of such agricultural changes, but these may have been proportioned by several factors, such as changing environmental conditions, and political, cultural, or economic reasons. Besides, the large *forum pecuarium* established in Roman times, without parallels at that time in Portugal, would have involved a periodic but great influx of people, including travelers and traders, who were perhaps responsible for the dissemination of several plants at this site. These ended up being distributed and consumed locally, entering into the diet of its inhabitants. A space that maintained its function for more than one millennium, being the market transferred to the centre of the village in the end of the 16th century, and used until the 20th century (Lima, 2017b). Thus, only through the continuity of the archaeobotanical studies at Freixo/Tongobriga as in other areas of Northwest Iberia, and integrating historical sources will be possible a better understanding of how those dynamics and events eventually conditioned the agricultural decisions and plant consumption in the past.

Funding

LS was financially supported by a PhD grant (Norte-08-5369FSE000057) from the University of Porto (Faculty of Sciences) and the European Social Fund, through the North Portugal Regional Operational Program "Norte 2020", under the announcement "Aviso Norte-69-201515-Formação Avançada (Programas Doutorais)". JPT was supported by national funds through the Foundation for Science and Technology (FCT).

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Table 2. Fruits/Seeds results per context, at Freixo/Tongobriga (continued on the next page).

Tabela 2. Resultados carpológicos por contexto em Freixo/Tongobriga (continua na página seguinte).

Context	**Wall**	***Impluvium* House**	**Round Hut**		
Chronology	**Iron Age**	**Late Antiquity**	**Late Roman**	**Iron Age**	
Volume (L)	**482**	**184**	**309**	**20**	
Cereal (grains)					**Total**
Avena sp.	3	1	5	3	12
Hordeum vulgare	7	6	3		16
Panicum miliaceum	396		76	2	474
Setaria italica	175	118	30		323
cf. *Setaria italica*		4			4
Panicoideae	665	27	43	1	736
Secale cereale	2	11		2	15
cf. *Secale cereale*	1	4			5
Triticum aestivum/durum	5		2		7
Triticum spelta	137		7		144
Triticum sp.	26	1	9	1	37
Triticeae (with scutellum)	12	7	4		23
Cereal (chaff)					
Hordeum vulgare (rachis segment with 1 node)	1		4		5
Panicum miliaceum (hulled grain)	2		1		3
Panicum miliaceum (grain with husks)	7				7
Setaria italica (hulled grain)	1				1
Panicoideae (grain with husks)	1				1
Triticum aestivum/durum (rachis node)			2		2
Triticum spelta (grain with husks)	1				1
Triticum spelta (rachis segment)	3				3
Triticum spelta (spikelet base)	15		1		16
Triticum spelta (glume base)	115		16	7	138
Triticum sp. (spikelet base)	10		5		15
Triticum sp. (glume base)	61	1	65	21	148
Other Poaceae (grains)					
Lolium/Festuca			1		1
Poa sp.		1	2	2	5
Poaceae	12	11	14	2	39
Fabaceae (seeds)					
Genisteae	26	1	19	2	48
Ornithopus sp.	1		1		2
Vicia/Lathyrus	30	13	20	1	64
Fabaceae - *Trifolium* type			2		2
Fabaceae	11	1	10		22
Fruits					
Castanea sativa (fruit)		3			3
Ficus carica (seed)			17		17
Quercus sp. (cotyledon)	5				5
Quercus sp. (cupule)	2				2
Rubus sp. (pyrene)	1	16	8		25
Sambucus sp. (pyrene)			3		3
Vitis vinifera (seed)		1	22		23
Vitis vinifera (pedicel)			19		19
Rosaceae (seed)	1				1

Table 2. Fruits/Seeds results per context, at Freixo/Tongobriga (continued from previous page).

Tabela 2. Resultados carpológicos por contexto em Freixo/Tongobriga (continuação da página anterior).

Context	**Wall**	***Impluvium* House**	**Round Hut**		
Chronology	**Iron Age**	**Late Antiquity**	**Late Roman**	**Iron Age**	
Volume (L)	**482**	**184**	**309**	**20**	
Others					**Total**
Asterolinon linum-stellatum (seed)	1				1
Apiaceae (achene)			2		2
Asteraceae (cypsela)	1	1	1		3
Caryophyllaceae (seed)	2		1		3
Carex sp. (achene)	1				1
Chenopodiaceae (seed)		1			1
Cyperaceae (achene)		2			2
cf. Cyperaceae (achene)	1				1
Corrigiola litoralis/telephiifolia (achene)			1		1
Dianthus sp. (seed)	1				1
Galium/Asperula (mericarp)	5	1	2		8
Lamiaceae (nutlet)	1		1		2
Linum sp. (seed)		1			1
Malva sp. (seed)	2		17		19
Montia fontana (seed)			26		26
Pinus sp. (bract)			1		1
Plantago sp. (seed)			1		1
Portulaca oleracea (seed)		1			1
Polygonum aviculare (achene)			3		3
Polygonum - lenticular type (achene)			2		2
Polygonum sp. (achene)			4		4
Polygonaceae (achene)			2		2
Raphanus raphanistrum (siliqua segment)	1	1	2		4
Rumex acetosa/longifolius (achene)	1				1
Rumex acetosella (achene)	2				2
Rumex sp. (achene)			23		23
Sherardia arvensis (mericarp)			1		1
Silene gallica (seed)			1		1
Spergula arvensis (seed)			1		1
Spergula sp. (seed)	3	1			4
Solanum sp. (seed)	2		40		42
Stellaria/Cerastium (seed)	1		3		4
Verbena officinalis (mericarp)			6		6
Veronica sp. (seed)			1		1
Viola sp. (seed)		1			1
Undetermined (pedicel)	1				1
Undetermined (tuber)	1				1
Undetermined (fruit/seed)	49	8	55	5	117
Total	**1,811**	**245**	**608**	**49**	**2,713**