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ARTICLE

Results of archaeobotanical analyses concerning Chalcolithic settlement excavations at Alcalar, Algarve, Portugal

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ABSTRACT

From the Chalcolithic settlement excavation at Alcalar, Algarve, 79 sediment samples were analysed in terms of archaeobotanical remains. A total of 450 carbonised items were recovered and identified: 9 cultivated plant taxa and 18 wild plant taxa. The find density per sample was quite low.

There were only two species of cereals unearthed: grains of free-threshing wheat (*Triticum aestivum/durum/turgidum*) and of barley (*Hordeum vulgare*) which in well-preserved samples was identified as naked barley (*Hordeum vulgare* var. *nudum*). In Chalcolithic Alcalar, remains of pulses were more numerous than cereal finds. Field bean/faba bean (*Vicia faba*) was found in 36.8% of the analysed samples (89 items). Additionally, one find showed characteristics of bitter vetch/lentil vetch (*Vicia ervilia*). Two oil seed plants were found: linseed/flax (*Linum usitatissimum*) and opium poppy (*Papaver somniferum*). The reported carbonised grapevine pip (*Vitis vinifera* s.l.) most likely derived from gathered wild grapevine. The wild plants identified were mostly belonging to ruderal or segetal stands, with a few from macchia and woodland. Some of the detected wild plant taxa

are of medicinal use, namely *Crataegus*, *Malva*, *Myrtus*, *Papaver*, and *Pinus*. *Beta*, *Corema*, *Myrtus, Pinus pinea* and *Quercus* may have been gathered for human consumption.

Keywords: Chalcolithic settlement; Botanical macroremains; Agriculture; Gathered plants; Cereals; Pulses.

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RESUMO

Setenta e nove amostras de sedimento recolhidas durante as escavações no povoado calcolítico de Alcalar, Algarve, foram alvo de um estudo arqueobotânico. 450 macrorrestos vegetais carbonizados foram recolhidos e identificados: 9 táxones cultivados e 18 silvestres. A densidade de vestígios por amostra era bastante baixa.

Só foram recuperadas duas espécies de cereais: grãos de trigo-nu (*Triticum aestivum/durum/turgidum*) e cevada (*Hordeum vulgare*) que, quando se encontrava bem preservada, foi identificada como cevada-nua (*Hordeum vulgare* var. *nudum*). Em Alcalar, durante o Calcolítico, os vestígios de leguminosas foram mais numerosos do que os cereais. Foram encontradas favas (*Vicia faba*) em 36.8% das amostras analisadas (89 itens). Adicionalmente, um elemento apresentava características de ervilha-de-pombo/gero (*Vicia ervilia*). Foram identificadas também duas plantas oleaginosas: o linho (*Linum usitatissimum*) e a papoila-do-ópio (*Papaver somniferum*). Uma grainha de uva carbonizada (*Vitis vinifera* s.l.) identificada deverá, muito provavelmente, resultar da recoleção de uvas silvestres. As plantas silvestres correspondem principalmente a espécies ruderais ou daninhas, tendo sido também identificadas poucas que advêm de maquis e bosques. Alguns dos táxones silvestres têm propriedades medicinais, nomeadamente *Crataegus*, *Malva*, *Myrtus*, *Papaver* e *Pinus*. *Beta*, *Corema*, *Myrtus, Pinus pinea* e *Quercus* devem ter sido coletadas para consumo humano.

Palavras-chave: Povoado calcolítico; Macrorrestos vegetais; Agricultura, Plantas recoletadas; Cereais, Leguminosas

Introduction

The prehistoric settlement of Alcalar is located in the western Algarve between the Bay of Lagos in the south and the Monchique Mountains in the north (Figure 1). Alcalar is estimated to be the power-centre of that large region from the 5th till the transition from the 3rd to the 2nd millennium BC being archaeologically grouped in Period I to V (Morán 2014; Morán *et al.* 2017). The here presented archaeobotanical data derived from Period IV, from 2800 BC onwards till the end of the 3rd millennium BC, when at Alcalar settlement a large agglomeration of buildings at an area of 25ha was established (Morán *et al.*, 2017). The central dwelling area on a plateau displays many storage pits enclosed

by a system of multiple fences with gates (see Morán *et al.*, 2017: Figure 2, 3) being accompanied by monumental graves with ceremonial related areas on several hills in its immediate surroundings to the north. Over the course of the preparations to turn the site of Tumulus 7 (Alc7) from Alcalar (Morán and Parreira, 2003; 2004; 2007; 2009) into a visitor-accessible, archaeological monument, sediment samples for archaeobotanical investigations were collected at the excavation site Alc7 to analyse botanical macro-remains. Unfortunately, the 7 samples recovered from the area around the circular stone cover of Tumulus 7 did not yield any prehistoric plant remains besides charcoal and did not contribute to the here presented examinations (Table 1). Results of wood charcoal analyses have already been presented by Yolanda Carrión elsewhere (Carrión, 2004; 2005). In addition to the mastic tree (*Pistacia lentiscus*), evergreen oaks (*Quercus* spp.) including the cork oak (*Quercus* cf. *suber*) and pine (*Pinus* sp.) were found.

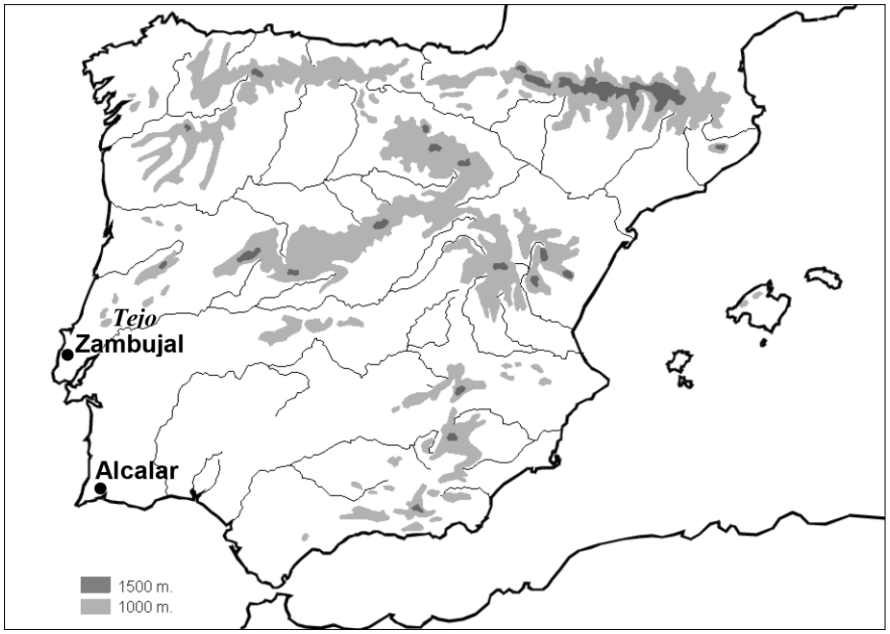

Figure 1 - Map of the Iberian Peninsula showing the locations of the two Chalcolithic sites of Alcalar and Zambujal, Portugal.

Palynological investigations of sediment profiles 5 km south of Alcalar between the Ribeira do Farelo and Ribeira da Torre near the Roman Villa ruins of Abicada show a supraregional trend towards a decrease in oak stands in favour of pine and macchia during the Copper Age, end of pollen zone B (*Quercus-Pinus*-Zone (6480–5090 cal. BP / 4530–3140 BC) and pollen zone Ca (*Pinus-Cistus* type-Ericaceae-Zone (5090–3910 cal. BP / 3140–1960 BC) of the core Abi 05/07, (Höfer, 2013, p.85 and Figure 23). The

simultaneous increase in grassland is probably due to an increase in the conversion of oak forests to pasture land, which can be deduced from the detection of spore remains of Sordariaceae (fungi on ruminant dung) in the pollen samples. In this pollen profile, agriculture is sporadically detectable due to pollen from cereal grains and accompanying herbs. The number of charcoal particles smaller than 100 µm also increased noticeably in this pollen zone, indicating a marked increase in the frequency of fires in the region. The increasing demand for wood and land during the expansion activities of the Copper Age explain the reduction in forest area and the increase in fires.

In the subzone Cb (*Pinus*-Ericaceae-*Cistus* type-Zone (3910–3550 cal. BP / 1960–1600 BC) of the pollen profile Abi 05/07 (Höfer, 2013, p.86 and Figure 23), a slight recovery of the oak stands as well as changes in the macchia composition occurs, which can be attributed to the beginning of the Bronze Age. The *Cistus* species decrease significantly in favor of the Ericaceae, while pistachios (*Pistacia* type), gorse (*Ulex* type) and olive (*Olea europaea*) increase. The use of grassland declines slightly, while agricultural impact generally appears to decrease in the investigation area during this phase. Regional fire events increase, as do the cork oaks (*Quercus suber* type), which can be related to the fire resistance of this tree species. The very heterogeneous distribution of finds from the Bronze Age in the Algarve region are mainly oriented to the copper ore deposits of the southern slopes of Serra de Monchique (Schubart, 1975). During the early Bronze Age in the territory of the Ribeira do Farelo and the Ribeira da Torre the local human impact by settlement activities is low and after this, increases with the developing Bronze Age in the pollen subzone Cc and Cd. The regional vegetation development could roughly be traced by the results of the pollen analysis of the profile "Abi 05/07 - Estuary of the Ribeira do Farelo and the Ribeira da Torre / Abicada" (Höfer, 2013). We now consider the botanical macro-remain results directly from sediments of the settlement excavation of Alcalar in the years 2000 to 2008 (Morán, 2008; 2010a; 2010b) to contrast them to palynological and charcoal results mentioned above.

Material and methods

During the archaeological excavation at Alcalar settlement site from Period IV, Chalcolithic (3rd millennium BC) in 2000, 22 archaeobotanical sediment samples were taken from 14 different excavated archaeological structures (all pits) and were decanted on site in a flotation barrel, with the floating sediment particles collected in a sieve set (finest mesh width of 0.5 mm). The dried "light fractions" were further processed in the Hohenheim archaeobotanical laboratory according to the standard methods there (for a description of the method see Stika, 1996, p. 18-20). A total of 57 sediment samples were investigated from the continuing excavation campaigns 2005 to 2008 at the same area and from the same occupation phase as the samples of campaign 2000 from various layers of three archaeological structures (Pit 798/182, Pit 780/167 and House 770/170) again from Period IV, Chalcolithic (3rd millennium BC).

The analysed sediment volume ranged from 2.5 to more than 100 L with a total of 2058 L in all 79 samples (average 26.05 L per sample).

Results of the botanical macro-remain analysis (Table 1)

In 29 out of a total of 79 samples, no definable prehistoric plant remains could be found apart from charcoal fragments. In all other samples, the number of finds was low and storage samples or other concentrations were not detected. In total, 450 plant residues were identified which are derived from cereals (136 grain remains, 32% of all plant remains), other crops (158 remains, 37% of all plant remains) and wild plants (135 residues, 31% of all plant remains).

Cereals

The samples examined yielded primarily signs of crop remains (67% of the plant remains). In the case of cereals, findings of wheat (63 grains) were the most common with findings in 36.7% of all samples. As far as the charred grains are concerned, most of the wheat residues originated from the free-threshing wheat varieties including bread wheat (*Triticum aestivum* s.l.), hard wheat (*T. durum*) or rivet wheat (*T. turgidum*) (Figure 2). For a more precise identification as tetra- or hexaploid wheat, well-preserved chaff remains are needed (Jacomet, 2006), which are completely missing in the analysed samples. During the prehistory of the Iberian Peninsula there are both tetraploid and hexaploid naked wheats existent (Stika and Heiss, 2013). Barley finds were the second most common with 19 grains found in 17.7% of all samples. Those grains that were well-preserved (6 in total) were identified as naked barley (*Hordeum vulgare* var. *nudum*), and it is likely that all 19 barley grains from Alcalar were naked barley. Some poorly preserved grains could not be identified and are listed as Cerealia Indeterminata.

Figure 2 - Carbonised grain of free-threshing wheat (*Triticum aestivum* s.l. / *T. durum* / *T. turgidum*) dorsal and ventral view; scale 1 mm.

Other crops

In addition, oil crops were found, including 16 finds of charred linseed (*Linum usitatissimum*) identified in 13.9% of all samples and poppy (*Papaver somniferum*), which was only found once, one seed only. From legumes, peas (*Pisum sativum*) and bitter vetch / lentils vetch (*Vicia ervilia*) were each represented by only a single charred seed. Of the field beans (*Vicia faba*),

Table 1 - List of analysed plant remains excavated at the Chalcolithic settlement site of Alcalar; sums and frequencies of appearance.

Alcalar				
Campaign		**2000+2013 79 samples**	**2000+2013 79 samples Frequency**	**plants**
Cereals				
Hordeum vulgare L.	grain	**13**	**11,4%**	barley
Hordeum vulgare L. var. *nudum* Spenn.	grain	**6**	**6,3%**	naked barley
Triticum L. sp.	grain	**12**	**7,6%**	wheat species
Triticum L. sp.	grain frag	**3**	**2,5%**	wheat species
Triticum aestivum L./*durum* Desf./*turgidum* L.	grain	**50**	**29,1%**	naked wheat
Cerealia Indet.	grain	**42**	**29,1%**	ceareals
Cerealia Indet.	grain frag	**8**	**6,3%**	ceareals
Cerealia Indet.	culm knot	**2**	**1,3%**	ceareals
Other Cultivated Plants				
Fabaceae, cult.	seed frag	**35**	**22,8%**	cult. pulses
Linum usitatissimum L.	seed	**16**	**13,9%**	lenseed, flax
Papaver somniferum L.	seed	**1**	**1,3%**	poppy
cf. *Pisum sativum*	seed	**1**	**1,3%**	pea
Vicia cf. *ervilia* (L.) Willd.	seed whole	**1**	**1,3%**	bitter vetch
Vicia faba L.	seed frag	**57**	**20,3%**	faba bean
Vicia faba L.	seed half	**21**	**11,4%**	faba bean
Vicia faba L.	seed whole	**11**	**8,9%**	faba bean
cf. *Vicia faba* L.	seed	**14**	**10,1%**	faba bean
Wild Plants (incl. used wild plants)				
Asteraceae Indet.	fruit	**1**	**1,3%**	scorzonera-type
Avena L. sp.	grain	**2**	**1,3%**	oat
Beta L. sp.	fruit frag	**1**	**1,3%**	beetroot
Bromus L. sp.	grain	**4**	**5,1%**	brome
Corema album (L.) D.Don	fruit stone	**4**	**5,1%**	white crowberry
Fabaceae Indet.	seed	**1**	**1,3%**	legume
Glebionis segetum (L.) Fourn.	fruit	**3**	**3,8%**	corn marigold
Malva L. sp.	inner fruit	**4**	**5,1%**	mallow
Medicago L. spp.	pog frag	**2**	**2,5%**	bur clover
Medicago L. spp.	seed	**2**	**2,5%**	bur clover
Medicago lupulina L.	seed	**1**	**1,3%**	yellow clower
Medicago L. sp. / *Trifolium* L. sp.	seed	**1**	**1,3%**	clover
Quercus L. sp.	cotyledon	**3**	**2,5%**	oak
Myrtus communis L.	fruit stone	**1**	**1,3%**	myrtle
Papaver L. sp.	seed	**1**	**1,3%**	poppy
Pinus L. sp.	cone frag	**76**	**27,8%**	pine
Poaceae Indet.	awn frag	**1**	**1,3%**	grasses
Poaceae Indet.	grain	**5**	**5,1%**	grasses
Scorpiurus muricatus L. s.l.	seed	**1**	**1,3%**	prickly scorpion's-tail
Sherardia arvensis L.	seed	**3**	**3,8%**	blue field madder
Thymelea hirsuta (L.) Endl.	seed	**1**	**1,3%**	hairy sparrow weed
Trifolium L. sp.	seed	**2**	**1,3%**	clover
Vitis vinifera L. *sylvestris* type	pip	**1**	**1,3%**	grapevine
Indeterminata	seed/fruit	**10**	**7,6%**	
Fruit	frag	**6**	**5,1%**	
Bread/Mash/Fruit	frag	**21**	**8,9%**	
Sum of Cereal Remains		**136**		
Sum of Other Cultivated Plants		**157**		
Sum of Wild Plants		**136**		
Total Plant Remains		**450**		

however, 103 seed remains were found in 35.4% of the samples. Charred remains of pulses and, above all, of oil fruits have a lower conservation probability than cereal grains. The importance of pulses and oil plants in cultivation and use is presumably underestimated in the low number of finds.

The decision whether to assign a charred grape seed (*Vitis vinifera*) to either cultivated plants or wild plants is difficult (Figure 3). The present-day cultivated grapevine most likely grew wild within the riverside areas of the forest. In its morphology, the grape seed found here resembles the wild grapevine (*Vitis vinifera* ssp. *sylvestris*) due to its spherical overall shape and the short stalk, but the stalk could be corroded. During the Chalcolithic period, wild grapevine is more probable, as current research shows that an increase in cultivation occurred in the late Bronze Age (Stika and Heiss, 2013).

Figure 3 - Carbonised pip of wild grapevine (*Vitis vinifera* ssp. *sylvestris*) in two views; scale 1 mm.

Wild plants

20 different taxa were identified in the group of "wild plants", which represent very different habitats. Some of the listed taxa can be gathered for human consumption. *Beta* (beet), *Corema album* (white crowberry) (Figures 4 and 5), *Myrtus communis* (myrtle) (Figure 6), *Quercus* sp. (oak) and *Pinus pinea* (Mediterranean stone pine) are wild plants that could have been consumed as roots and/or leafy vegetables (*Beta*), berries (*Corema album, Myrtus communis*) or high-starch (acorns) fruits and high-fat (stone pine seeds) seeds.

Figure 4 - Carbonised fruitstones (3 items) of white crowberry (*Corema album*) in two views (top and middle) and in one view (bottom); scale 1 mm.

While *Beta* sp. and *Corema album* grow on coastal and dune sites, *Quercus* sp., *Pinus* sp.

and *Myrtus communis* are representative of forests and their degradation stages. An actual publication gives archaeobotanical and ethnobotanical details on *Corema album*, the white crowberry (López-Dóriga, 2018).

Figure 5 - Modern fruitstone of white crowberry (*Corema album*) in two views; scale 1 mm.

However, most of the identified wild plant residues are ruderal and segetal in character and originate from anthropogenic sites such as field areas, settlements or pathways. This includes *Avena* sp. (oats), *Bromus* sp. (brome), *Glebionis segetum* syn. *Chrysanthemum segetum* (corn marigold) (Figure 7), *Malva* sp. (mallow), *Medicago* spp. (bur clover), *Sherardia arvensis* (blue field madder), *Trifolium* sp. (clover), *Medicago lupulina* (yellow clover), Poaceae (sweet grass), and *Scorpiurus muricatus* (prickly scorpion´s-tail). Some of the identified taxa are good fodder plants for domesticated animals and may have been introduced into the settlement as feed or through animal droppings which could have been used as fuel (Stika, 2001, p.325-326). This includes the grasses and various species of clover. Hairy sparrow weed (*Thymelea hirsuta*) has adapted as a xerophyt to extremely dry locations and grows in garrigue or on cleared fields.

Figure 6 – Carbonised (left) and modern (right) fruitstone of myrtle (*Myrtus communis*); scale 1 mm.

Several fruits and seeds could not be identified (Indeterminata and fruit fragments). Blown up (by carbonisation) organic remnants were found in 7 samples that may have originated from bread, mash or fruit pulp.

Figure 7 - Carbonised fruitstone of corn marigold (*Glebionis segetum*) in two views; scale 1 mm.

Conclusions

The sediment samples from the excavation of the settlement of Alcalar (Period IV, Chalcolithic), with a total of only 450 identifiable plant residues, yielded a first picture of the cultivation and use of plants in human nutrition at the site. Free-threshing wheat (*Triticum aestivum* sl / *T. durum* / *T. turgidum*) was the dominant grain (36.7% frequency of appearance) during the Copper Age in Alcalar, while free-threshing barley (*Hordeum vulgare* var. *nudum*) was of a lesser importance (17.7% frequency). When considering only the samples with identifiable plant residues, the frequency values of naked wheat are 58% and naked barley 28%. Of the other crops, the faba bean/field bean (*Vicia faba*) is dominant (35.4% frequency). If only the samples with identifiable plant residues are taken into account, the frequency rises to 56%. Linseed/flax (*Linum usitatissimum*) is subdominant. The occasional finds of pea, lentil and grape vine indicate that the spectrum of cultivated and gathered plants is quite broad, while the main crops are clearly naked wheat and field bean. This corresponds very well with the archaeobotanical results from the Zambujal complex (Prov. Extremadura), where 355 sediment samples were analysed, which yielded a representative result (Stika, in prep.).

The intensive use of wild plants in the diet in Alcalar is similar to other pre- and protohistoric sites on the Iberian Peninsula (see Alonso *et al.*, 2016). While the use of acorns (*Quercus* sp.) for human nutrition and animal feed in prehistoric Spain and Portugal is widespread (Alonso *et al.*, 2016), stone pine nuts (*Pinus pinea*) can only be collected regionally in areas close to the coast near their natural distribution area, which can be proven for Zambujal (fragments of seed-shells of *Pinus pinea*, see Stika in prep.) and can be assumed for Alcalar (here only fragments of pin scales of *Pinus* sp.). Alcalar shows evidence of gathered fruits, in the form of myrtle (*Myrtus communis*) and white crowberry (*Corema album*), which were occasionally detected as charred remains. The other wild plant residues from anthropogenic sites (ruderal and segetal vegetation) have also been frequently detected at other excavations and reflect

some instances of well nutrient-supplied stands. Carboniferous layers of the Jura (Lopes, 2006, in Höfer, 2013, p. 27), which can supply nutrient-rich soils with their weathering, are common around Alcalar. Free-threshing wheat is very demanding with regard to soil quality. The dominance of naked wheat in the cultivation areas around Alcalar reflects a good soil quality.

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