

Chromatography
and
DNA
analysis
in
archaeology

Archaeoanalytics - Chromatography and DNA analysis in archaeology



Editors
CÉSAR OLIVEIRA
RUI MORAIS
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IDENTIFICATION OF A PRODUCTION OF ROMAN AMPHORAE IN NORTHERN LUSITANIA

VIRGILIO HIPOLITO CORREIA

Conimbriga Monographic Museum and Porto University, Portugal

IDA BURACA

UNIAHQ

RICARDO TRIÃES

GEOBIOTEC, UDACRP, Instituto Politécnico de Tomar, Portugal

ALFREDO ARAÚJO

Chemistry Centre, Minho University, Portugal

CÉSAR OLIVEIRA

Chemistry Centre, Minho University, Portugal

ABSTRACT

Among the amphorae of the Roman city of Conimbriga a new regional class of amphorae production was identified not yet described in bibliography. This production is characterized regarding their morphology and manufacture (regional), the proposed general location of the production center (north of Lusitania, in all likelihood the lower Mondego basin) and proposals are made as to their chronology and use (wine amphora of the I to III c. AD).



Amphora (T-7.4.3.3.)
Castro de S. Lourenço (Vila Chã)
"Sea of Stories" | Centro Interpretativo de S. Lourenço temporary exhibition

INTRODUCTION

The systematic study of amphorae from Conimbriga that has been undertaken by one of the present authors (Ida Buraca) increases the total fragments known from archeology of the Roman city from the fifty-eight fragments published in the *Fouilles de Conimbriga* (Alarcão *et al.*, 1976, 89-91) to a minimum number of individuals that can be estimated at this time, as hovering 500 (a multiplication by a factor close to 10). This study also allowed the identification of a production class of Roman amphorae that is not yet described in the literature and that seems to deserve autonomous treatment. This identification raises some methodological issues that can be immediately addressed.

The first question has to do with the methodology of the study that led to this identification. The amphorae of the French-Portuguese excavations in Conimbriga that were catalogued represent only a small amount of the fragments collected in the excavations, which is indicated as slightly exceeding 200 pieces (Alarcão *et al.*, 1976, 80).

It seemed well advised to:

- i) verify the typology of uncatalogued fragments attributed to identified classes;
- ii) classify specimens that were then identified as imported coarse wares (*ibid.*, 74-77, n° 58 ff), and not as amphorae;
- iii) make an inventory and classification of amphora fragments, identified as such or not, in several excavations in the city, including the excavations of 1953-55 in the House of the fountains (Oleiro, 1992, 145-148), in 1963- 1972 in the Zone B (Alarcão, 2010, 11-17) and, since 1990, in various domestic buildings (Correia, 2013, 21-23), and
- iv) verify the existence of amphora fragments among the materials of the old excavations and integrate them in the study, despite the absence of specific contexts for these pieces.

Naturally, the current study is benefiting from the growing knowledge on amphorae productions that has been increasing exponentially since the 1970s. Consequently, the level of the completeness of the cataloging and typological analysis is necessarily much larger, whilst previously assigned classifications are, to a large extent, not very operative in the present state of our knowledge. Furthermore, it should be noted that the amphorae were not a class of material especially benefited by research, within the French-Portuguese excavations in Conimbriga, as they were not part of the material groups discussed in the round table of Conimbriga March 1975 (Alarcão and Etienne, 1975, *passim*). For these and other reasons, a special impetus was given to the review of this class of materials in Conimbriga (Correia, 2004a, 126), in line with the activity of the Museum in this area (Alarcão and Mayet, 1990, 5-7).

Secondly, it seems important to stress the methodological importance of identifying an amphorae class in a consumption center instead of identifying the production center through the location of its archaeological remains. This fact has parallels in other situations where present knowledge is, in fact, much more dense, such as Roman amphorae productions in the Tagus valley; there despite the available data from pottery workshops (Filipe and Raposo, 1996 *passim*), it was in a distribution/consumption center (Lisbon) that a production that does not match any of the workshops so far studied was identified through physical-chemical analysis (Dias *et al.*, 2012, 57-70).

The situation presented here is identical with the difference, which is of degree but not in nature, that it concerns the identification by morphological analysis of a production class in a region where no production center is as yet identified.

Finally, it must be stressed the importance of the use of available analytical methods which allow to characterize the production and the origin of the raw material, and to identify the products whose packaging and shipping these containers were used for.

Conimbriga boasts an accumulated knowledge on clays composition; beginning with the analysis of the course ware groups identified in the French-Portuguese excavations (Alarcão, 1975, 159-181), which were then pursued in depth for one of them in particular,

the fine gray pottery (Alarcão and Correia, 1994, 99-102, with previous references). With new methods, this study model was then extended to the ceramic building materials (Correia *et al.*, 2004b, 311-316 with all references), which are the main field of research of another of the present authors (Ricardo Triães).

In these circumstances, preliminary empirical questions were made and properly demonstrated:

- i) the amphorae productions in question should be regarded as pertaining to the coarse ware groups known in Conimbriga as the quartz-micaceous or coarse orange pottery groups;
- ii) the center of production should be located in proximity to the city;
- iii) the clay sources used should have also been exploited for construction materials and utilitarian wares.

In regard to the identification of the transported substance(s), an issue on which another of the present authors (César Oliveira) is developing the application of gas chromatography, it is a virtually indispensable tool nowadays, since their availability is generally assured, for an exhaustive investigation of these materials and unveil a very important aspect of the archaeology of the surrounding Conimbriga territory, in a broad sense.

The amphorae of the class Conimbriga 45-46

Eleven pieces have been identified so far as pertaining to this class (c. 2% of all amphorae identified in the town). They have been catalogued elsewhere (Correia *et al.*, in publication), so only a brief indication of the pieces will be given here. The identified pieces are:

- nº1 - 71.CRIP-NORTE.Cano - Almost complete amphora (Figure 1);
- nº2 - 69.TEM.III (1) and nº3 - 70.H.VIII.34 (5) - beak fragments published by Alarcão *et al.*, 1976, pp. 91 and 141, nº45-46;
- nº4 - 70.R5(1),
- nº5 - 69.H.VII.41(3)
- nº6 - 67.H.VI.24(3)
- nº7 - 70.H.VIII.34(8)
- nº8 - 71.TH.4(1)
- nº9 - 67.ESP/S(3)
- nº10 - 67.CRY.2(3), various fragments of the mouth of different amphorae (Figure 2)
- nº11 - 72.B.F6, a substantially preserved bottom half of an amphora from the excavations of J. Alarcão at the Zone B of Conimbriga (Figures 3.a and 3.b).

The theoretical reconstruction of this amphora class has a height of about 46.5 cm and a maximum width of almost 25 cm. The rim is of rounded section and thickened to the outside with an outer diameter around 18 cm. We do not have any preserved handles but according with the negative left in the neck and body fragments, they would be placed below the rim and on the shoulder and have a slightly concave section. The short neck of the amphora opens directly to the shoulder (Figure 3.a). The body has an ovoid shape and the beak is short (Figure 3.b).

The form of these amphorae, is to be classified *sui generis*, but it can be included in the group (whose identification is recent but that gradually is showing to be more numerous) of small amphorae of local production and limited circulation. These are known, for example, in the provincial capital of *Emerita Augusta* (Alba & Mendez, 2002, 389-390 and 398; Bustamante, 2011, 33), and perhaps in the valley of the river Sado (please see Morais, 2013, 106 with an earlier bibliography).

The identification of the piece nº1 - 71.CRIP-NORTE.Cano, between the materials not selected for study in the French-Portuguese excavations (probably because it was a find of the last years of excavation and it needed an appreciable extent of restoration, so



Figure 1 - Fragments of 71.CRIP-NORTE.Cano amphora.



Figure 2 - Fragments of Conimbriga 45-46 amphorae.

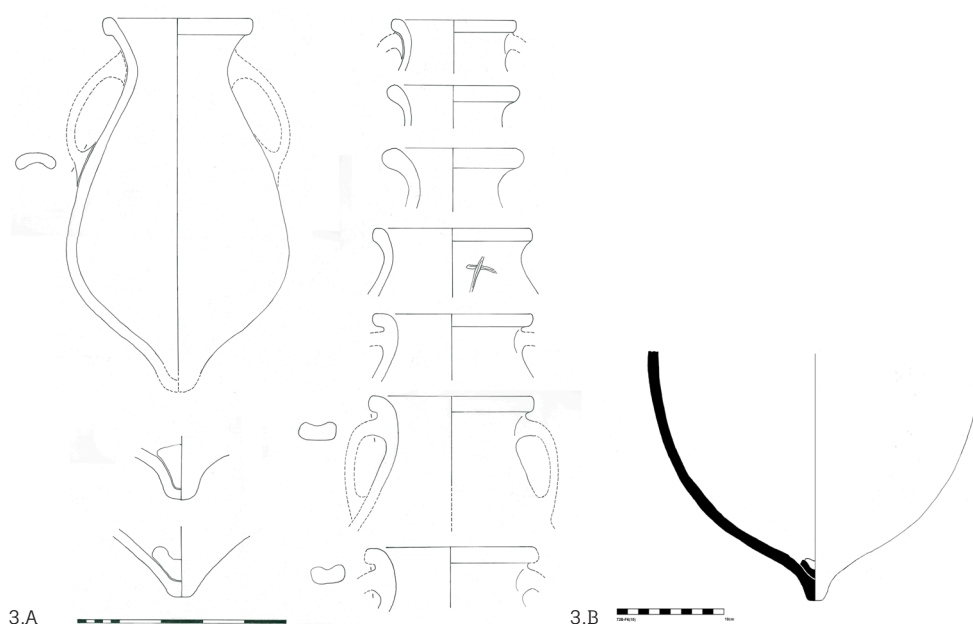


Figure 3.A - General view of 72.B.F6 amphora.

Figure 3.B- Bottom of 72.B.F6 amphora.

it was not the object of the attention that, retrospectively, it seems worthy of), allows to go beyond the expressed perplexity about the pieces nº 45 and 46 of the *Fouilles de Conimbriga* (Alarcão *et al.*, 1976, 87) and in context with the other assignable pieces here identified, permits their analysis as an independently identifiable class, with a sufficient number of individuals.

The contexts of the finds and the dating of the amphorae

The identified fragments come from six different stratigraphic horizons, five of them identified and published in the *Fouilles de Conimbriga* and another identified in Jorge Alarcão's excavations in the Zone B of the city, specifically in the cryptoporticus of the building south of the main road (for specific discussions, see Correia *et al.*, in publication).

In chronological order, the relevant horizons are the following:

- Horizon 19 - Construction of the Flavian forum (c 80 AD; Alarcão and Etienne, 1977, pp. 196-204). Fragments nºs 2 - 69.TEM.III (1) and 9 - 67.ESP / S (3).
- Horizon 20 - Forum sewers (80 AD and later; id, *ibid*, pp. 205-210). Amphora nº1 - 71.CRIP-NORTE.Cano.
- Horizons 24 and 26 - Construction and soils of the Trajanian baths (*Id, ibid*, pp. 214-228). Fragment nº8 - 71.TH.4 (1).
- 2nd phase of the cryptoporticus of the building south of the main road (Alarcão, 2010, pp. 14-22). Amphora 11 - 72 B-F6 (10).
- Horizon 35 - Late repaving of the *palaestra* of the baths (Alarcão & Etienne, 1977, pp. 234-235). Probably fragment nº4 - 70.R5 (1).
- Horizon 45 - Forum destruction (*Id, ibid*, pp 244-246). Fragment nº10 - 67.CRY.2 (3). Fragments nº3 - 70.H.VIII. 34 (5), nº5 - 69.H.VII.41 (3) and nº7 - 70.H.VIII.34 (8), come from the insula of the phallic vessel, from unassigned horizon levels. They are also more likely to be redeposited material.

We must conclude that the production of this amphorae class is established in the last quarter of the I c. AD or earlier. Its use certainly extends along the IInd c. and probably the IIIrd c. It is less secure it was still in use during the IVth c.

EXPERIMENTAL SECTION

Ceramics composition

The identification of the crystalline phases was performed by X-ray diffraction (XRD) using a Phillips equipment with a PW 1710 controller, a PW 1050/81 goniometer and CuK α radiation. All the samples were reduced into powder before analysis and presented, as principal crystalline phases, the most common for those types of materials (Figure 4). The equipment was operated with 45 kV and 45 mA, and the mineralogical composition of the samples was determined in a range of 4-60 °2 θ .

The chemical composition of the clays was obtained by Wavelength Dispersive X-ray Fluorescence (WDXRF). The analysis of the major elements was carried out on lithium borate glass fusion beads (Spectromelt A12) in a ratio of 1:9, while the analysis of the trace elements was done on pressed powder pellets (Tables 1.a and 1.b). Both tablets were analyzed in a Phillips 1410/00 spectrometer, using radiation of CuK α . The loss on ignition was obtained through the boiling of the samples to 1000°C for 3 hours.

Data was analyzed using two multivariate statistical analysis techniques:

- i) Principal Component Analysis (PCA) with a normalized data matrix,
- ii) Cluster Analysis (CA) using the Ward's method and the Euclidean distance as the similarity parameter.

Sample	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	MgO	CaO	Na ₂ O	K ₂ O	TiO ₂	P ₂ O ₅	LOI
CNBANF1	46.3	14.9	3.3	0.5	16.2	0.3	1.4	0.5	0.3	15
CNBANF2	67.8	20.5	5.6	0.9	0.4	0.3	2.3	0.7	0.3	1.2
CNBANF3	64.5	20.5	4.7	0.8	1.1	0.4	2.4	0.7	0.5	4.4
CNBANF4	76.9	13.6	4.0	0.6	0.6	0.6	1.8	0.6	0.3	1.0
CNBANF5	63.5	23.7	5.7	0.6	0.8	0.2	2.7	0.6	0.3	1.7
CNBANF6	74.0	17.1	2.5	0.4	0.4	0.2	2.9	0.5	0.2	1.6
CNBANF7	63.8	25.6	4.5	0.5	0.3	0.2	2.6	0.7	0.3	1.2

Table 1.a - Chemical composition of clays (%).

Sample	Sc	V	Cr	Mn	Ni	Cu	Zn	Ga	As	Rb	Sr	Y	Zr	Nb	Sn	Cs	Ba	La	Ce	Nd	Pb	Th	U
CNBANF1	14	66	53	155	17	18	84	16	7	127	207	22	155	12	8	16	441	34	61	28	24	12	5.1
CNBANF2	10	106	90	97	22	24	95	23	10	173	30	26	219	15	10	13	404	28	54	25	33	14	3.1
CNBANF3	10	78	68	207	30	24	119	22	7	225	84	32	231	18	13	22	530	39	92	44	37	18	6.9
CNBANF4	7.7	60	55	309	17	21	46	12	11	93	62	22	155	9	4	5	303	21	43	22	34	7	2.9
CNBANF5	8.3	41	49	224	19	45	74	28	15	274	64	45	283	28	23	30	308	68	166	83	48	33	5.8
CNBANF6	4.4	23	26	68	6	12	32	17	8	211	46	26	339	20	17	21	279	32	78	37	31	29	7.6
CNBANF7	9.2	45	38	176	19	27	107	32	12	295	143	41	232	30	25	21	478	59	124	60	47	30	12

Table 1.b - Elemental composition of clays (ppm).

Analysis of the vessels content by gas-chromatography with mass detection

Fragments of "71.CRIP-NORTE.Cano" and "72.B.F6" amphorae were studied regarding their primary organic content. About 0.2 g of ceramic material was scrapped from each sample. The materials were crushed into a fine powder on an agate mortar and extracted sequentially with dichloromethane and methanol in a Soxhlet apparatus. The organic extracts were filtered with 0.20 μ m PTFE syringe filters and concentrated on a rotary evaporator to about 2 mL. The extracts were transferred to vials, dried with a gentle nitrogen flow, dissolved in pyridine and derivatized with N,O-bis(trimethylsilyl)trifluoroacetamide (BSTFA): trimethylchlorosilane (TMCS) 99:1 for the analysis of the most polar compounds.

The analysis were performed on a VARIAN 4000 Performance chromatograph operating in full scan mode on the following conditions: a) column DB-5MS, 30 m x 0.25 mm x 0.25 μ m using helium as carrier gas with a constant flux of 1 mL min⁻¹; b) injection volume of 1 μ L; c) injector temperature of 250 °C; d) heating program: 60 °C to 150 °C (10 min⁻¹); 150 to 290 °C (5 °C min⁻¹); 290 °C (27 min); e) acquisition mode, electronic impact of 70 eV; f) interface and ionic source at 290 °C; g) scanned masses from 50 to 600 m/z. Compound identification was based on the GC-MS spectra libraries (Wiley and NIST), co-injection with authentic standards and analysis of fragmentation patterns.

RESULTS

The clay sources and the location of the production center

Regarding the contents of the analysed elements, the samples showed some heterogeneity (Figure 4). This aspect was evident for the major elements, namely SiO_2 , Al_2O_3 and Fe_2O_3 , as well as for the minority elements. As mentioned, CNBANF1 sample had a high content of CaO, which corresponds to the presence of calcite.

Figure 5 (PCA) shows a wide dispersion between samples, which represents a relative heterogeneity between them. Figure 6 (CA) corroborates the above observations and demonstrates a good compositional homogeneity between the two pairs of samples. Despite the small number of samples and their compositional heterogeneity, the variance explained for the first two components in the PCA is 69.2%, and most variables contribute decisively to their definition.

Given the relative similarity of the compositional characteristics between common clays used in the production of *Conimbriga* industrial ceramics territory, the compositional data for these seven samples were conjugated with other data obtained previously (Triães *et al.*, 2012) in order to understand if it would be possible to consider the samples as local production. These are samples obtained in the same conditions that the construction ceramic and loom weights, totalling 102 samples, taken from excavations in the city of *Conimbriga* and *Aeminium* and the *villae* of *Rabaçal* and *Dordias*.

Figure 7 (PCA) results of these data combination and lets one easily realize that there is a clear trend towards the separation of the samples into two major groups. One of the biggest groups of samples with a clear compositional identity corresponds largely to the samples collected in *Conimbriga*. The group of samples from *Rabaçal*, with a significant number of samples representatives of various types, is the one that presents greater dispersion, and within it there is a faction that seems to be clearly distinct from the previous. With the samples from the city of *Aeminium*, which are fewer in number, there's a situation similar to the case of the *Rabaçal* group, *i.e.*, there's significant heterogeneity. The reduced number of the villa of *Dordias* samples does not allow precise conclusions, since the dispersion is great, but it seems to integrate the *Conimbriga* group. A more detailed analysis of the *Conimbriga* territory samples shows that two small groups emerge and are clearly distinct from the two main groups.

In order to better understand the associations between samples within this group, only the samples collected in the area of the city of *Conimbriga* were taken into account - 61 samples, corresponding to 24 loom weights, 30 to ceramic construction and 7 amphorae were considered. Figure 8 shows the same trend in the association of the variables that define the components, although the K_2O content appears to contribute to the definition of the 1st component and Al_2O_3 and SiO_2 have less influence, which appears to point out a lesser relevance of the reaction between clay and aggregate.

Given the data obtained through the statistical study, it seems clear that the samples from the set of *Conimbriga* territory can be separated into two major groups, highlighting a large group of samples with origin in the city of *Conimbriga* (including construction ceramics, loom weights and amphorae) and a group of samples from the roman villa of *Rabaçal*. The analysis of the samples from the city revealed that this large group had a high dispersion, justifying a division into two independent groups. One of the groups was largely homogeneous, comprising the majority of samples, while the second group presented a much higher dispersion. The first group is richer in K_2O , Rb, Na, Sn, Nb, Zr, in opposition to the second, which is richer in Cr, V, Ni, Cu and Fe_2O_3 . This relation points to a division based on the general composition of the used clay and its geological setting, given that the correlation between the aggregate and clay is not sufficient to explain differences between the two groups.

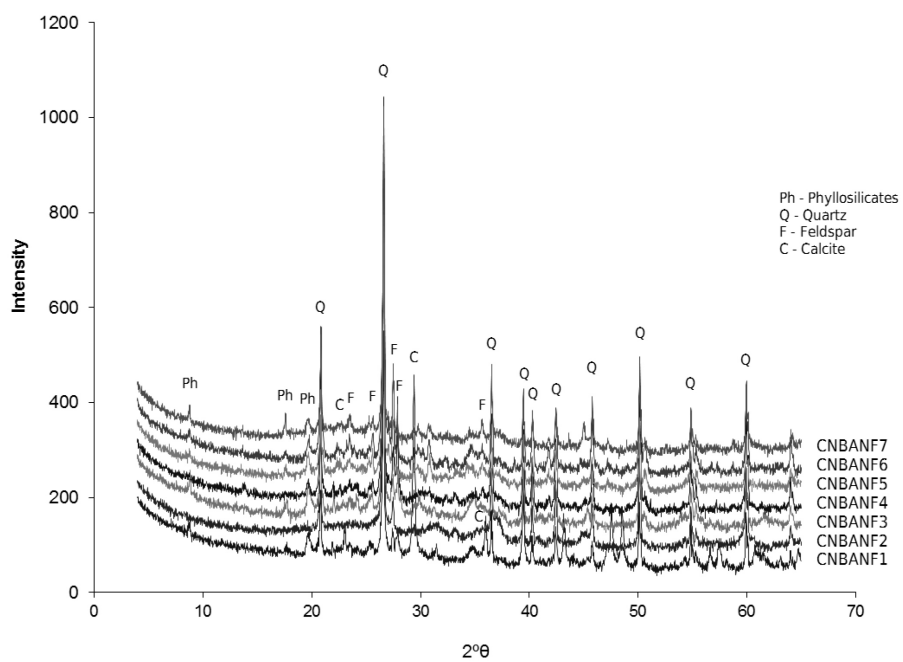


Figure 4 - XRD patterns of Conimbriga samples.

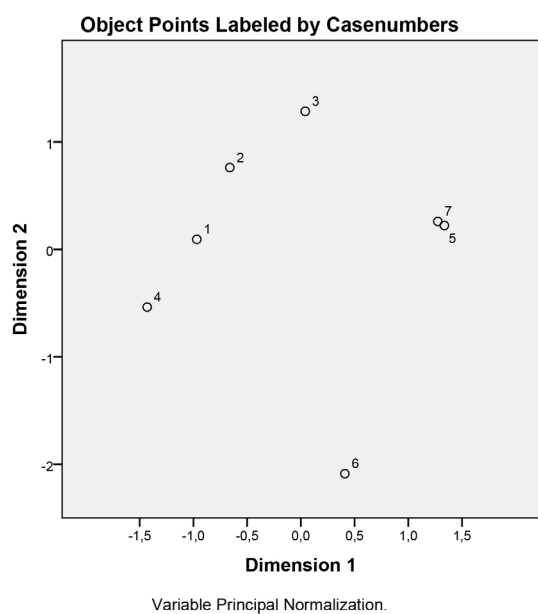


Figure 5 - PCA projection.

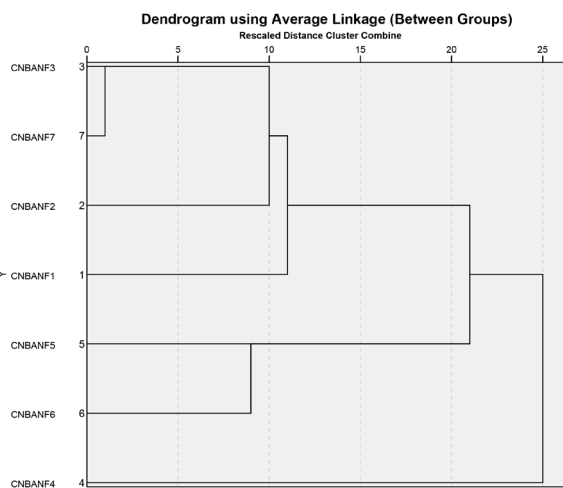


Figure 6 - Similarity dendrogram.

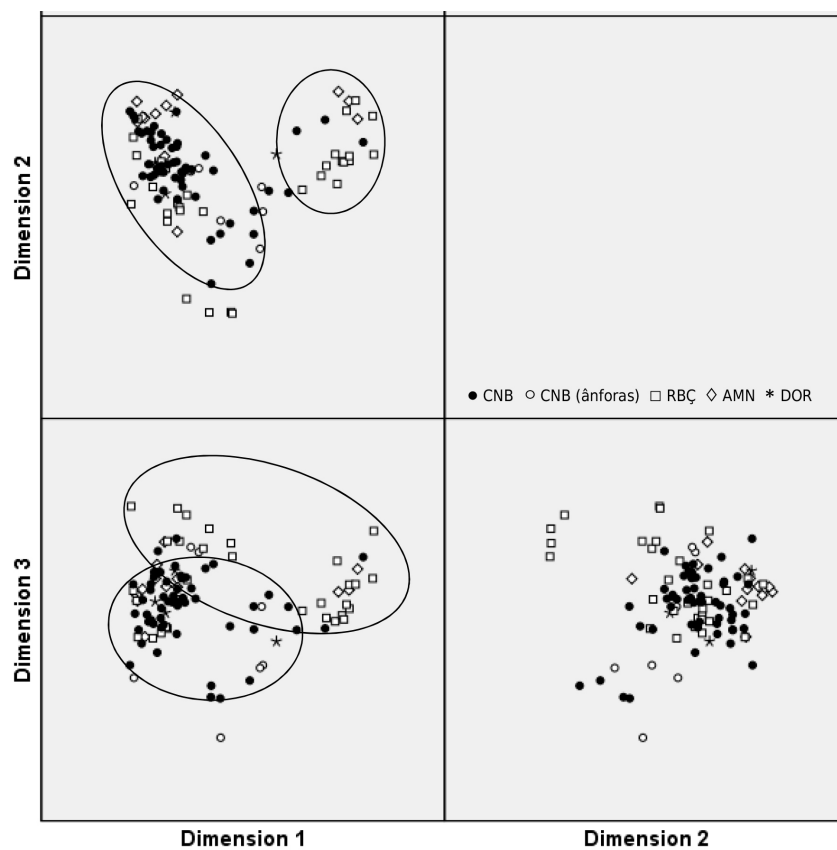
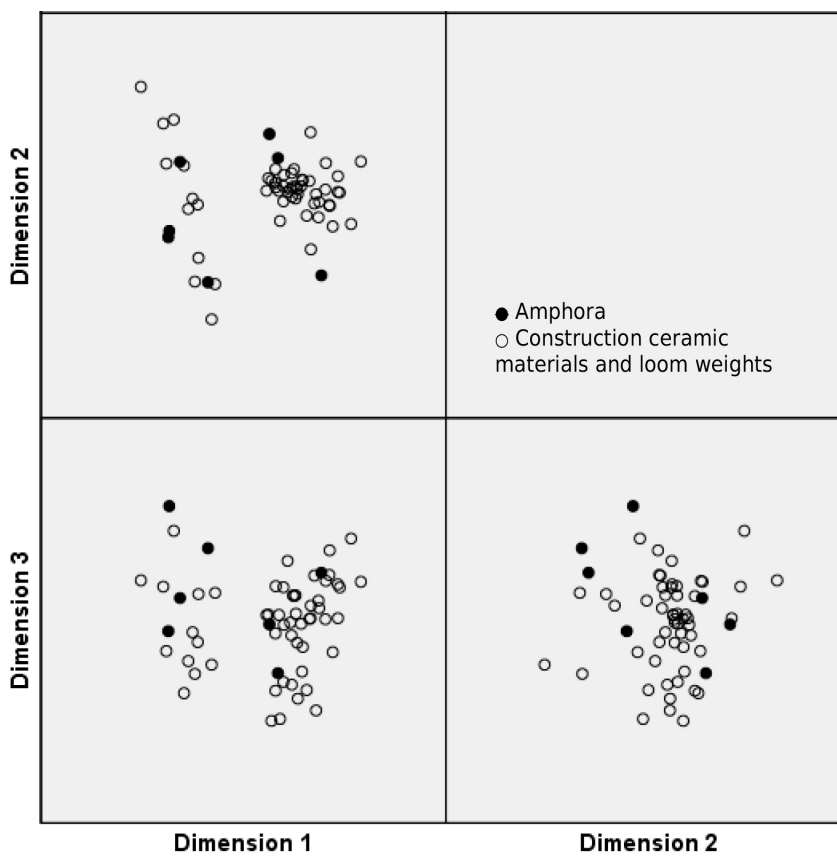


Figure 7 - PCA projection for the first three sample components of Conimbriga, Aeminium, Rabaçal and Dordias cluster



Variable Principal Normalization.

Figure 8 - PCA projection for the first three sample components of Conimbriga cluster.

Thus it seems to have existed, along the development of the city of *Conimbriga*, more than one local supply of clay raw material for the production of industrial ceramics. Consequently we can find materials originating from different areas of installation of the workshops, which explored the local clay resources. Through the compositional and technical data, particularly with regard to the identified crystalline phases and firing temperature limits, which show a good consistency, it is possible to assume that there would be a specialization on the type of materials produced in each workshop. In both groups that result from the statistical analysis there are samples of construction ceramic materials of diverse types, weights and tear amphora.

The utilitarian wares analyzed

The macroscopic analysis of the amphorae of class Conimbriga 45-46 was thought to be indistinct from some common ceramic types of Conimbriga, namely quartzo-micaceous and coarse orange pottery, which M.T. Seixas identified, respectively, as originating from coverage clays of the Pliocene and from the region comprised between Penela, Condeixa and Soure (Alarcão, 1975, 165-172). In the study of these coarse wares from Conimbriga, small *opercula* had been identified in all likelihood amphora stoppers, fact that gains a particular significance in this context.

A set of six samples of previously identified coarse wares from Conimbriga was selected, to which was added a sample of piece nº1. Hence, out of seven samples, three correspond to amphorae (nº1 and Alarcão 1975, nºs 343 and 347, 72). These samples received the conventional designation ANF, in the following manner:

- ANF 1 = nº 1 71.CRIP-NORTE.Cano
- ANF 2 71.PAL18(1), *id.*, *ibid.*, nº 75 (Group 6 - Alarcão, 1975, 50-52 e 164-165)
- ANF 3 68.FOR2(2), *id.*, *ibid.*, nº 81 (*id.*)
- ANF 4 69.PAL.T9(1)=69.TH.I-2(1), *id.*, *ibid.*, nº 330 (Grupo 13 supra)
- ANF 5 68.G-VIII-36(9), Alarcão, 1975, nº 343 (Group 13 - Alarcão, 1975, 72-73 e 170-172) amphora *operculus*
- ANF 6 64.G-VI-6(5), *id.*, *ibid.*, nº 347 (*id.*) *ditto*
- ANF 7 66.H-VI-39(10), *id.*, *ibid.*, nº 349 (*id.*)

In summary, the utilitarian wares analyzed (two samples of group 6 - Alarcão 1975, 50-52 and 164-165, two samples of group 13, *id ibid*, 72-73 and 170-172; other two samples of the same group from amphora *opercula* and a sample of an amphora of Conimbriga 45-46 class) were produced using generally the same raw material of ceramic building materials and industrial products from Conimbriga. More data on the diffusion area of these products is available in Correia *et al.*, 2004b, 313-315.

All things considered, the local production of amphorae of the Conimbriga 45-46 class can be taken as demonstrated. It is clear, however, that the research of this production needs, from this point onwards, further development, including the multiplication of analyses on fragments from Conimbriga and elsewhere, when their identification takes place.

The use of amphorae 71.CRIP-NORTE.Cano and 72.B.F6

Figures 9.a and 9.b present the chromatograms of the MeOH extracts of 71.CRIP-NORTE.Cano and 72.B.F6 amphorae fragments, and Table 2 a brief reference on some of the detected compounds.

One of the formulated hypotheses was that these amphorae were used for the transport of olives and/or olive oil. The reduced presence of oleic acid, the major component of olive oil, together with the absence of typical compounds as valencene or α -muurolene, seems not to corroborate this thesis. Instead, both samples presented chemical markers for the presence of wine, particularly the organic acids tartaric, fumaric, malic, succinic, azelaic, mandelic and cinnamic (Barnard *et al.*, 2011; Jerković *et al.*, 2011; McGovern, 1998). The detection of quercetin, oleanitrile, phytol and isoeugenol points to the presence of plants and/or seed oils (Ferreira *et al.*, 2002; McGovern *et al.*, 2009; Michael, 1999).

Several biomass burning tracers were detected, particularly in sample 72.B.F6 which presented the higher intensities of these compounds. Both samples presented levoglucosan, a chemical smoke marker produced by the thermal breakdown of cellulose and hemicellulose, widely present in bark of trees, branches and leaves (Colombini *et al.*, 2003; Simoneit, 2002; Simoneit *et al.*, 1999; Jerković *et al.*, 2011). The chromatograms showed also pimaric acid, a compound indicative of the presence of *pinaceae*, and several diterpenoid acids as abietic acid, dehydroabietic acid and 7-oxo-dehydroabietic acid, markers for pine resin in aged materials (Colombini *et al.*, 2003; Jerković *et al.*, 2011). The detection of these compounds indicates that the amphorae content was contaminated with biomass burning emissions, so the content should have been heated or boiled, probably with the referred plants and seeds. Another possible explanation is the use of a fumigation procedure to clean the winery, wine storage vessels and other paraphernalia for winemaking (Geoponika VI, 11 *apud* White, 1970b).

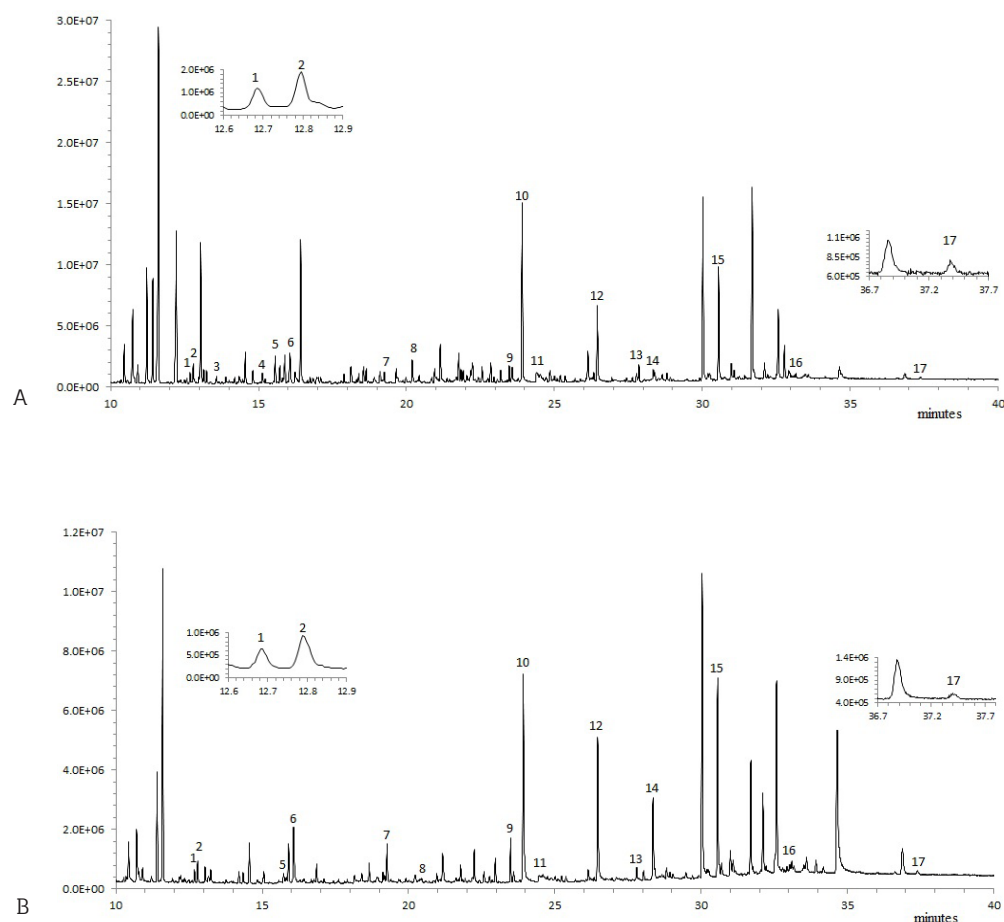


Figure 9 - Full scan mode chromatograms of the MeOH extracts of 71.CRIP-NORTE.Cano (a) and 72.B.F6 (b) amphorae fragments.

Number	Compounds	71.CRIP- NORTE.Cano	72.B.F6
1	Tartaric acid	✓	✓
2	Fumaric acid	✓	✓
3	Phytol	✓	
4	Isoeugenol	✓	
5	Malic acid	✓	✓
6	Proline	✓	✓
7	Levoglucozan	✓	✓
8	Azelaic acid	✓	✓
9	Palmitelaidic acid	✓	✓
10	Palmitic acid	✓	✓
11	Oleanitrile	✓	✓
12	Stearic acid	✓	✓
13	Pimaric acid	✓	✓
14	Dehydroabietic acid	✓	✓
15	Abietic acid		✓
16	7-oxodehydroabietic acid	✓	✓
17	Lycopersene	✓	✓
18	Cholesterol	✓	✓

Table 2 - Some compounds detected on the methanolic extracts and their correspondence in chromatograms of Figs. 9.a and 9.b.

DISCUSSION

At a first glance, the analyses suggest we are dealing with a container of wine of an uncommon typology. This leaves open any judgment as to the possible quality of production (Ricci, 1924, 61-65).

The issue of plant material present can find several explanations with references in the Natural History of Pliny (André, 1958, *ad loc.*):

- Ash (such as lime) could be added to reduce the acidity of wine (*Nat. Hist.* 126 and 129), a use also mentioned by Cato (*De Agr.* 23) and Columella (12, 19, 27).

- The resin which coated the amphorae could sometimes be burned or smoked (*Nat. Hist.* 127).

- The wine could also be artificially aged by smoking or heating, which was carried out in the *apotheca* (*Nat. Hist.* 16 and 94). There is also a reference to an African habit made popular by Tiberius, as mentioned by Cato (*De Agr.* 7, 2.): the addition of raisins, smoked in the forges to perfume the wine.

Furthermore the possible presence of burning resinous material can be explained by the fumigation of presses with incense, as an hygienic measure mentioned in *Geoponica* (VI, 11. *apud* White, 1970b). One can imagine that a hygiene measure such as this was used in other steps of the winemaking process and that there were eventually other resin products used, rather than incense.

GENERAL DISCUSSION AND MAJOR CONCLUSIONS

The identification of this amphorae class makes justice to C. Fabião's intuition (2004, 381-382 and 388) about amphorae productions on the north of Tagus river, but most importantly it underlines the fact of documenting, for the first uncontroversial time, the production of wine amphorae in the province of Lusitania (Etienne and Mayet, 2000, 12, especially note 9; against Fabião and Guerra 1993, 1012.).

However, the most relevant aspect is perhaps the fact that the identification of these amphorae as wine containers indicates their integration in the development of high-revenue yielding agriculture in the region of Conimbriga. The spread of wine culture was part of this process, and it resulted in the very significant diminishing (to the virtual disappearance) of imports of wine amphorae into the city around the end of I and II AD (Correia and De Man, 2010, 301-302).

This situation was equated with the assumption that the wine produced began to be transported in *dolia* or wooden casks (Fabião, 1998, 184). This latter container can, in fact, have played a substantial role, but the production of amphorae now identified, which is coupled with the remarkable development of pottery production and the organization of their production in well-organized workshops which often marks the production with graffiti (Correia, 2004b, 221-225) shows the capacity of local economies to project themselves out of the *civitates* limits unfettered.

The role of the *dolia* may in fact have been instrumental in the production phase of the wine cycle as I.V. Pinto (1997, 135-149) demonstrated through an ethno-archaeological example illustrating Cato (quoted in White, 1970a, 392- 393). The «archaeological landscape» resulting from this mode of production, *i.e.* wide dispersions of Roman sites diagnosed almost exclusively by the presence of *dolia* and *tegulae* (Burgess, 1987, 99; Willis, 1987, 52-56) has, in fact, some echo in what is known from the archaeological surroundings of Conimbriga (Pessoa, 1986, 53-73). This issue suggests future lines of research for the archeology of the area, particularly as to the characterization of the farming activity as primarily dependent on *villae* (Alarcão, 1999, 130-134) or the existence of a strong component of agriculture development whose headquarters is properly urban (Correia, 2013, 335); in all fairness, as how indeed to balance between one and the other realities in our reconstructions of past realities.

Another line of research arising from the identification of this amphorae class obviously is the determination of its diffusion sphere. We must wait for the impact of the present and other related papers within the interested scientific community and expect pieces so far classified as common pottery to be identified as amphorae of this class. This would seem very likely since at level of the isolated fragments, the absence of striking features can be almost complete and the misidentification of these amphorae as common coarse ware quite natural; but it is obvious that a small production, which may perhaps be designated as «marginal» in full propriety, may have had a circulation sphere and an overall volume of production too small for their testimony in the archaeological record to be today indeed rare.

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