Lusitanian Amphorae: Production and Distribution

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Inês Vaz Pinto,* Rui Roberto de Almeida and Archer Martin*****

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Contents

Lusitanian Amphorae of the Augustan Era and their Contents: Organic Residue Analysis[1]

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In this study we present amphorae of the Augustan era collected in Portugal and in Galicia revealing that they were not a 'premature' or 'experimentation' production but the result of a complementary phenomenon related to products from Baetica.

Taking into account the growing interest in the theme of amphora contents, analysis of organic residues present in Lusitanian amphorae by Gas Chromatography coupled with Mass Spectrometry (GC/MS) were conducted. The results obtained revelatory clues about the original contents of these amphorae.

KEYWORDS: LUSITANIAN AMPHORAE; AUGUSTAN ERA; AMPHORA CONTENTS; ORGANIC RESIDUE ANALYSIS; GAS CHROMATOGRAPHY; FISH-BASED PRODUCTS.

The early productions of Lusitanian origin[1]

The period of Augustus signals a strong change in the economic and commercial structures throughout the Empire. The province of Lusitania did not go untouched by this reality, and soon became an active producer and an important exporter of fish-based products, as witnessed by the production centres and pottery workshops that manufactured amphorae.

Lusitanian amphorae dating to the Augustan era were identified at Castelo da Lousa (Mourão, Évora) and in Aljube (Porto), and presented by one of the authors of this study (Morais 2003; Morais 2010). As well as at these sites, amphorae of similar types from archaeological sites located along the Atlantic coast, in Galicia (Castro de Panxón, Montecastro and Castro de Vigo) and from the region between the Minho and Douro Rivers (Castro de Santa Luzia, Castro da Terronha - both in Viana do Castelo; Porto, Rua da Banharia; Castro de Fiães, Vila da Feira) were presented. Later, various sets with the same formal characteristics, corresponding to the earliest productions were published (Quaresma and Calais 2005; Arruda, Viegas and Bargão 2006; Pimenta *et al.* 2006; Morais and Fabião 2007; Filipe 2008a; Filipe 2008b; Mataloto 2008).

Most likely inspired by Italian and Baetican shapes, these amphorae present an enormous formal variety. Generally, they are characterized by having short necks and handles, with an identical oval or more or less cylindrical body, similar to the known Baetican amphorae Haltern 70 of earlier production, including the so-called 'small variant' or Ovoide type 4 from the Guadalquivir region (Almeida 2008; García Vargas, Almeida and Gonzalez Cesteros 2011). Some fragments show formal characteristics that seem to fit in the so-called Lusitana 12 type in the typology of Dias Diogo (1987: fig. 7) and are also very similar to the first productions of Dressel 14, Variant A of Françoise Mayet and Carlos Tavares da Silva (2002).

According to the fabrics, these earlier productions must come from the pottery workshops located along the Tagus and Sado Rivers, with probable prevalence of the productions from the Sado Valley (Mayet and Silva, in this volume; Pimenta, Ferreira and Cabrita, in this volume). Besides these production centres, a pottery workshop in Morraçal da Ajuda (Peniche), from Augustan times, is also known (Cardoso and Rodrigues 2005; Cardoso, Rodrigues and Sepúlveda 2006; Cardoso *et al.*, in this volume) that produced amphorae similar to the Dressel 7-11.

Contents and their problematics

One of the most interesting problems related to the study of the amphorae is the question of the preferential products transported in certain types, according to their formal characteristics and production areas. For Lusitanian amphorae and, in particular, for the ones considered in this study, it is normal to think that they were destined to transport salted-fish and derivatives, like the Dressel 14 amphora. To answer this question we considered analyzing organic residues present in Lusitanian amphorae by Gas

[11] This study was performed on the scope of the PTDC/EPH-ARQ/5204/2012 project. We thank Fundação para a Ciência e Tecnologia (FCT) and FEDER (European Fund for Regional Development) - COMPETE-QREN-EU for financing Centro de Investigação em Química da Universidade do Minho (CQ/UM) [PEst-C/QUI/UI0686/2011 (FCOMP-01-0124-FEDER-022716)]. César Oliveira thanks FCT for his contract on the scope of the 'Ciência 2008' program.

Chromatography, coupled with Mass Spectrometry (GC/MS). The results obtained on fragments of amphorae collected in consumption environments, namely the 'ovoid Lusitanian' type and amphorae similar to the Dressel 7-11 from Peniche, and their comparison with other fragments of Dressel 14 types, dated to the early Empire, reveal clues about their original contents.

Fundamental for the results obtained was the possibility of analysing the remains of fish-based products still conserved in the internal base of a *doliola* from the Roman site of Boca do Rio (Lagos), dated from the end of the 4th century or early 5th century AD,[2] whose results we shall now present.

Lusitanian amphorae studied

Four different amphorae were studied: an 'ovoid amphora' from Castro de Vigo (Pontevedra, Spain), an amphora similar to a Dressel 7-11 from Peniche collected at Braga (Cavalariças, no. 1997-1031), a Dressel 14 *parva* and a Dressel 14 (or possibly an ovoid amphora[3]) from Braga (Albergue Distrital, no. 1997-0451 and 1994-0315) (Figure 1). As the bibliographic data on Lusitanian amphorae pointed to their possible use as containers for fish-based products, it was crucial to know what were the best organic tracers to undoubtedly identify this organic matrix. This goal was achieved by performing a complete analysis procedure on the remains of fish-based products, including fish bones and teeth, collected in the *doliola* from Boca do Rio (Lagos).

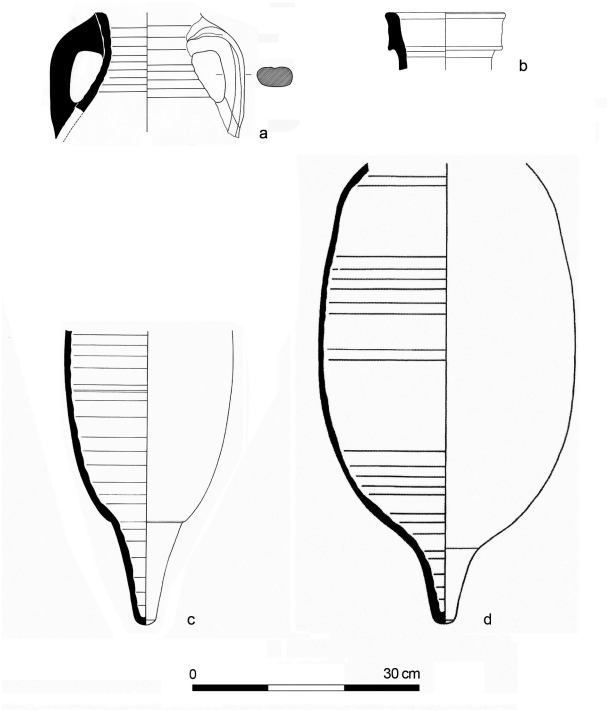

Figure 1. Lusitanian amphorae studied: a) ovoid amphora from Castro de Vigo, Pontevedra, Spain; b) amphora from Peniche, similar to a Dressel 7-11 (Braga, Cavalariças, no. 1997-1031); c) Dressel 14 *parva* amphora from Albergue Distrital at Braga (no. 1997-0451); d) Dressel 14 amphora (or ovoid type) from Albergue Distrital at Braga (no. 1994-0315).

General procedures for sample extraction and chromatographic analysis

Aliquots of about 0.2g were scratched from the ceramics surface and crushed with a pestle in an agate mortar. A similar procedure was used for the analysis of fish-based products. The triturated fragments were Soxhlet extracted sequentially with dichloromethane and methanol and analysed by GC-MS after a derivatization procedure by addition of BSTFA, N,O-Bis(trimethylsilyl) trifluoroacetamide with 1% Trimethylchlorosilane (TMCS).

An ion-trap GC-MS Varian 4000 Performance equipment was operated with the following conditions: a) 1 µL injection in SCAN mode, 250 ºC of injector temperature, b) column DB-5MS, 30 m × 0.25 mm × 0.25 µm; c) helium as carrier gas at a constant flow of 1 mL min^{-1}; d) heating program totalizing 45 min: 60 ºC (1 min); 60 to 80 ºC (10 ºC min^{-1}); 80 to 290 ºC (7 ºC min^{-1}); 290 ºC (12 min); e) acquisition mode, electronic impact at 70 eV; f) interface and ion source at 290 ºC; g) scanned masses from 50 to 600 *m/z*. Compound identification was based on the comparison of resulting spectra with mass spectra libraries (Wiley 6 and Nist08), and co-injection with authentic standards and analysis of fragmentation patterns.

Results

Processed fish remains from Boca do Rio

Figure 2 presents a chromatogram corresponding to the methanolic extract of the processed fish remains collected inside a *doliola* from Boca do Rio. The extracts were abundant in carbohydrates as the monosaccharide fructose, the disaccharide sucrose, altrose, arabitol or inositol, particularly the methanolic fraction that exhibited very high intensities of these compounds. The number of different carbohydrates and their high intensities suggest that the fish-based products were artificially sweetened. The detection of carbohydrates together with malic, succinic and lactic acids suggests the addition of honey (Derat-Carrière and Pochon 2009) or sweet wort.

The analysis also revealed traces of plant essential oils, as isoeugenol, a phenylpropenoid produced by plants that nowadays is used as a fragrance or flavouring agent, oleanitrile and oleamide, two compounds also qualified as vegetable oil tracers (Pecci *et al.* 2013), and stigmasterol, an unsaturated plant sterol occurring in plant oils from vegetables, nuts or seeds. The detection

[2] We thank João Pedro Bernardes for a sample of the contents of this *doliola* and the information on this piece.
[3] Even though the body of this amphora is more egg-shaped than usual in a Dressel 14, the lack of handles and neck does not allow to classify it with certainty as an ovoid amphora.

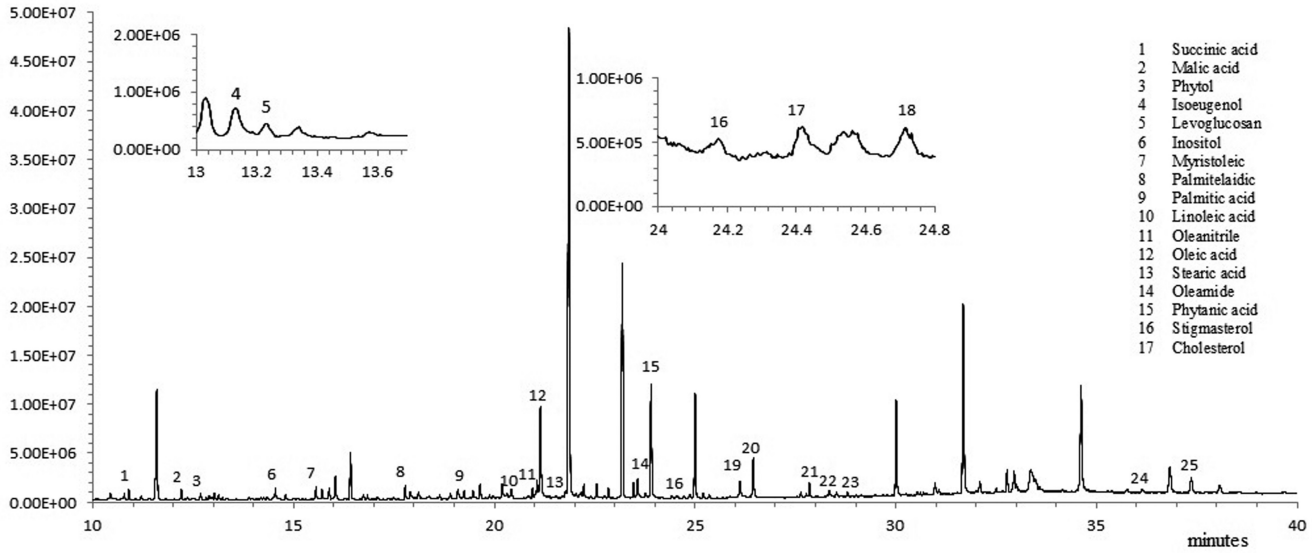

Figure 2. Chromatogram of the fish remains organic extract.

of these compounds suggests either that plants or herbs were added during the processing of fish or at least that the fish processing products were in a close proximity and under the influence of plants or herbs exudates. The detection of levoglucosan, a universal tracer for vegetal biomass burning (Oliveira *et al.* 2007; Caseiro and Oliveira 2012) suggests that the fish processing products were subjected to the influence of smoke, being either cooked or smoked.

A last group of compounds points undoubtedly to the presence of fish-based products. Cholesterol is usually considered a tracer to animal-based products like meat, animal oils or milk. However, though not as abundant as in meat products, cholesterol can also be found in lipids from marine origin. Cholesta-3,5-dien-7-one is a derivative of cholesterol. Additionally, omega acids as linoleic, palmitoleic or myristoleic are typical of fish-based products (Aquerreta, Astiasarán and Bello 2002; Cramp and Evershed 2014). Phytanic acid is also considered an appropriate tracer for fish derivatives.

All together this data provides good evidence for the processing of fish and serves as a model for the analytical study subsequently performed.

Organic residues from Lusitanian amphorae

The analytical results obtained were very similar within the four amphorae. Therefore, Figure 3 presents two typical chromatograms concerning an ovoid amphora and a Dressel 14 *parva* amphora.

The four samples had a large number of peaks from carbohydrates, with relative high intensities pointing to artificially sweetened products compatible with the addition of honey or sweet wort. The presence of cholesterol, phytol, phytanic acid and several omega acids, with particular emphasis on eicosadienoic acid, points indubitably to the presence of fish derivatives. Vegetable oil tracer compounds such as isoeugenol, oleanitrile, oleamide, germacrane and germanicol indicate the addition of either plants or herbs to the processed fish, or at least that the fish processing products were in a close proximity and under the influence of plants or herbs exudates. Several vegetal biomass burning tracers were detected, particularly levoglucosan, a thermal degradation product of cellulose, and several resin acids that are oxidation products of abietic acid, as dehydroabietic acid, 7-oxodehydroabietic acid and 15-hydroxy-7-oxodehydroabietic acid. This strongly suggests that the fish processing products were subjected to the influence of smoke.

Final remarks

The analytical results obtained strongly support the hypothesis that the Lusitanian amphorae presented here contained fish-based products. The high amounts of carbohydrates detected suggest the addition of sweeten products like honey or sweet wort. Several vegetal biomass burning tracers were detected, indicating that fish processing products were under the influence of smoke, being either cooked or smoked. The presence of several vegetable oil tracer compounds indicates the addition of either plants or spicy herbs to the processed fish, or that the fish processing products were in a close proximity and under the influence of plants or herbs exudates.

The data from the analysis seems to find correspondence with some passages from ancient authors such as Pliny (*HN* XXXI 95) when he refers *Melligarum/Mellogarum* and, indirectly Apicius (*De re coq.* 1, 8) when he mentions that fish based-products of inferior quality had a nauseating odor, contrary to good quality products made with mackerel blood. For that reason it would be necessary to cover the odour using a recipe based on fumigation with laurel or cypress, with some honey or fresh must.

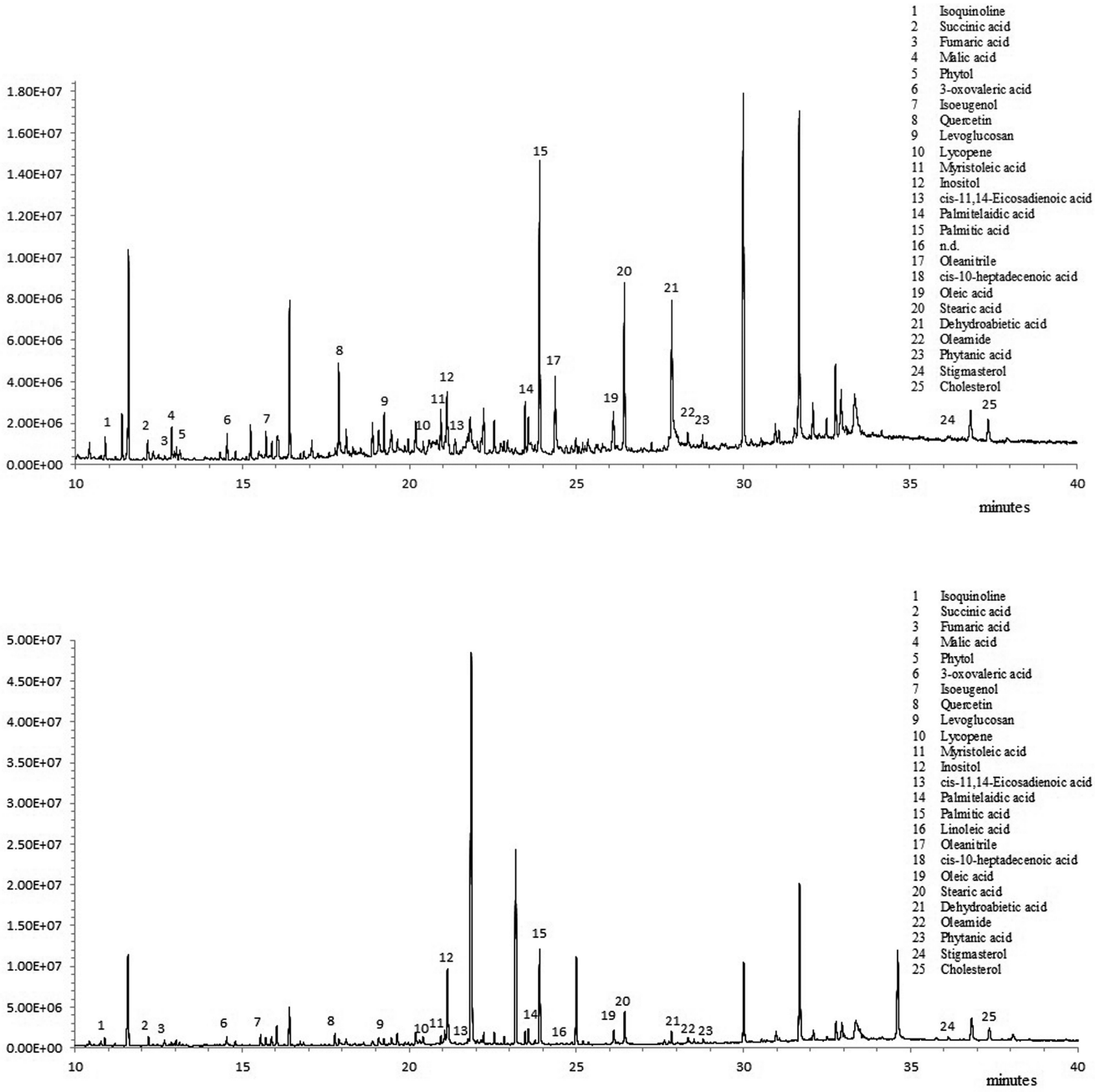

Figure 3. Typical chromatograms of Lusitanian amphorae: i) ovoid amphora from Castro de Vigo, Pontevedra, Spain (Figure 1.a); ii) Dressel 14 *parva* amphora from Albergue Distrital at Braga (no. 1997-0451) (Figure 1.c).

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