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► To cite this version:

Darío Bernal-Casasola, Michel Bonifay, Alessandra Pecci, Victoria Leitch. Roman Amphora Contents: Reflecting on the Maritime Trade of Foodstuffs in Antiquity (In honour of Miguel Beltrán Lloris). Conclusion. Darío Bernal-Casasola; Michel Bonifay; Alessandra Pecci; Victoria Leitch. Roman Amphora Contents: Reflecting on the Maritime Trade of Foodstuffs in Antiquity (In honour of Miguel Beltrán Lloris). Proceedings of the Roman Amphora Contents International Interactive Conference (RACIIC) (Cadiz, 5-7 October 2015), 17, Archaeopress, pp.499-504, 2021, Roman and Late Antique Mediterranean Pottery, 9781803270623; 9781803270630. halshs-03506188

HAL Id: halshs-03506188

<https://shs.hal.science/halshs-03506188v1>

Submitted on 13 Jan 2022

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Conclusion

It is difficult to speak of a ‘conclusion’ in such a fluctuating and developing field of research. The delay in publication means that the aims of the *Roman Amphora Contents International Interactive Conference* in October 2015 – to publish the latest research in the field – have been compromised by the more recent publication of several case studies and the launch of ambitious multidisciplinary research programmes.

The question of amphorae contents, particularly during their intense diffusion in the Roman period, has underpinned all studies devoted to these artefacts, which are so abundant on all archaeological sites in the Mediterranean and beyond. It is therefore no coincidence that this conference has been dedicated in honour of one of the main pioneers of such studies in Spain, Professor Miguel Beltrán Lloris. Other prominent specialists were also welcomed, those who laid the foundations for the study of Roman amphorae and their contents in the second half of the 20th century, in particular our colleagues and friends Fanette Laubenheimer, Stefanie Martin-Kilcher and André Tchernia.

These same specialists were the first to ask this destabilising question: what is the real importance of amphorae in the overall transport of foodstuffs in Roman times?

Indeed, it should not be forgotten that ‘las ánforas son sólo una parte del comercio’ (see above Beltrán Lloris). Even if we exclude the case of the *dolia*, whose traces as transport containers can be found in shipwrecks (and which even generated the production of new amphorae in locations where wine arrived in bulk), and small ceramic containers, whose quantitative importance can be demonstrated every day by archaeological research, what is the economic weight of the amphorae, whose capacity rarely exceeds 30 litres, compared to the gigantic quantities of products transported in barrels?¹ Moreover, barrels, and skins, are better adapted to land transport than amphorae.

Nevertheless, as noted in the foreword, referring to the 1986 Siena conference, we cannot deny the importance of amphorae for the ancient economy and therefore for the economic history that archaeologists and historians are trying to recreate. Even if amphorae are not the only vector of maritime trade in Roman times, they are a concrete indicator of this trade, and we need to know more about their contents.

In this field, today as yesterday, things still come in the form of questions:

¹ See the example of *Vindolanda*: 2 900 litres of oil and wine in 50 amphorae in comparison, but 11 000 litres of wine in 10 barrels (Marlière and Torres Costa 2005).

The link between typology and content, can it be trusted?

In the chapters by S. Martín Kilcher and A. Tchernia the reader will be able to reflect on the concepts that have concerned researchers since the beginnings of amphorology: monovalence (amphora x = content x), bivalence and multifunction. This is a key aspect for studies of the ancient economy. Our opinion, and that of the authors within this monograph, is that in Roman times each type of amphora was conceived at a specific time and in a specific region to store a particular type of product: otherwise, how do you explain the diversity of the typology? Thus, monovalence (each type or family of amphorae = certain content) must have been the normal situation from at least the Augustan times onwards. There are of course exceptions to this rule, such as the Haltern 70 which are bivalent, taking into account their use for the transport of olives and wine derivatives (mainly the thermally reduced grape must known as *defrutum* or *sapa*, much appreciated for their high potential as a preservative). There may have been moments of experimentation, as happens in the 1st century BC with the well-known ‘ovoids’, until the relationship between container and content was systematized in the different productive areas. Regarding polyvalence (versatility), this system seems typical of the period preceding the Roman-Republican era, in which there are very few types or even a single family, as is the case with the Phoenician-Punic world and other pre-roman communities using transport amphorae. Polyvalence of contents could also occur at the end of the Roman imperial system of distribution of goods (centred on the ports of Rome) as demonstrated by the African so-called *spatheia* of the first half of the 5th century (Bonifay, *supra*).

Tituli picti: are they useful for the determination of content?

The painted inscriptions alluding to the contents constitute, without doubt, potentially the most useful tools in relation to the history of research on these topics. However, there are very few examples in the Roman world, if we compare them with the number of known amphorae (a ratio of perhaps 1/1000 would be an approximate indicator, with exceptions such as at the well-known Monte Testaccio at Rome). The most abundant examples, in the well-known Dressel 20, do not provide information on the content, as is well understood. The two most extensive series of *tituli picti* are those of the early Imperial *garum* Baetican amphorae (studied by E. García Vargas and by P. Berni and E. Botte) and the Late Roman *dipinti*, especially in various families of Eastern amphorae (synthesized by J.-L. Fournet). Mentions of *vinum* and *oleum* are quickly recognized; as well as some fish products such as *garum*, *liquamen*, *muria*

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or *allec*, although there is no exact consensus between the semantic nature of all these fishery terms, which could refer to diverse products with varied ingredients;² although it is not disputed that these are all products made with marine resources (although terrestrial meat is used in some cases, such as *garum mixtum*). Also interesting are the references to products of less ‘direct’ interpretation, such as *laccatum*, recently considered by some authors as *lacertus*, alluding to young mackerel;³ or the *cordyla* or ‘young tunas’ of some Baetican amphorae, interpretations derived from very convincing and coherent philological studies, but which do not find an empirical demonstration (to date, no amphorae with these inscriptions associated with bones of these species have been found). When we have the epigraphic data and the archaeozoological evidence in the same amphorae, as happens with Dr. 21/22 of the Bottega del Garum in Pompeii, the interpretations are complicated, giving the impression that various products were made with similar fish (Bernal-Casasola *et al.* 2014). So the more information we have available, the more complex the interpretation becomes, as always happens in historical-archaeological investigations. This is one of the aspects that needs to be developed in the future.

Another element that should be introduced in this debate is the assessment of whether the *tituli picti* were occasional or whether, on the contrary, all or most of the amphorae were labelled in Antiquity. This is a much debated question, such as attributing its widespread presence on the Dr. 20 at Rome’s Monte Testaccio to the uniqueness of these productions, fiscally controlled by the Roman *annona*. As Emilio Rodríguez Almeida proposed at the time – followed by other colleagues such as P. Berni – the most logical explanation is that all the amphorae had *tituli picti* at the time of their labelling as archaeological contexts in good conservation conditions seem to demonstrate, such as the aforementioned case of Pompeii or on some well-known Mediterranean wrecks.

As we will see later, interdisciplinarity is needed to better face the problem of amphorae contents, and *tituli picti* should be related to the analysis of the content of the vessels (solid or liquid).

The reuse of transport amphorae: exception or routine?

T. Peña (see above) raises an important issue, that could also apply to barrels, to call into question the relevance of amphorae as evidence of the nature and direction of trade. The evidence for the reuse of amphorae for storage and transport is undeniable; there are numerous cases of this from written sources and archaeology, including on wrecks. The question is how widespread this phenomenon is. Is it universal or confined to certain regions (e.g. Egypt,

as literary sources seem to show, or the Provençal coastline for the transport of pitch in reused amphorae)? Is it permanent or more characteristic of certain periods (e.g. Late Antiquity, according to the example of Yassi Ada)? T. Peña outlines several avenues of research to identify these reuses: superimpositions of *tituli picti* or unusual *tituli picti*, multiplicity of visible or chemical traces of contents, evidence of deterioration and repair of the amphorae or their stoppers. Ahead of further research on this issue, we should be cautious about the contents of the various types as one moves away from the coastline. It is clear that an amphora found in a rural site far from the coast is less likely to show evidence of its original contents than an amphora found in a port city, and the latter is itself less informative than an amphora found in a wreck. This questioning of the validity of amphorae to inform us about their primary content according to where they were found should lead us to be even more cautious in our economic and historical interpretations. It should also encourage us to better select the amphora samples submitted for chemical analysis, giving priority to wrecks and port contexts. Nevertheless, shipments such as the famous Grado wreck contents should not, for the time being, lead us to immediately ‘throw the baby out with the bathwater’.

Chemical analyses: a question of interpretation? Can we trust them?

Organic residue analysis has been applied for several decades to investigate the content of amphorae. Condamin and Formenti were real pioneers on the subject and today we can confirm some of the data they obtained with more reliable techniques. Although much time has passed, we still need to discuss the achievements and the problems of organic residue analysis.

Organic residue analysis relies on the identification of what are called ‘biomarkers’, that are the chemical fingerprint of the ancient substances that were in contact with the ceramic matrix (in the case of amphorae). However, it is not easy to identify these biomarkers and the papers presented here demonstrate that a lot has still to be done. An important issue is that fresh substances differ from ancient ones because of degradation due to different causes that are mainly related to the production (i.e. burning of wood to produce pitch), transformation of the fresh substances as well as degradation and post-depositional processes. All these factors make the identification of the original contents of amphorae based on organic chemical analysis a difficult and still debated subject. However, we are far better positioned than a few decades ago, as several projects have shown.

While until a few years ago we still had to rely on indirect information provided by the presence/absence of a visible pitch coating to address amphorae contents (mainly wine vs oil), we can now directly identify the residues of the substances preserved. One of the greatest achievements over the last few years is the possibility

² Recently analyzed, for instance, in Grainger 2021: especially 5–6, 115–130.

³ A recent interpretation of this product in Djaoui 2016.

of identifying grape/wine and possibly other fruit biomarkers. This has led to an important change in the interpretation of the contents of amphorae where a wine/related content was only deduced from the presence of an organic coating identified either by chemical analyses (Heron and Pollard 1988) or preserved as a visible lining. Although some amphorae analysis still investigates only the organic coating of the amphorae, analyses are now generally much broader. The identification of fish biomarkers allows for a better understanding of the content of ancient amphorae that are seen to be much more complex than previously thought.

Another step forwards in organic residue analysis is that we are finally able to analyse series of amphorae. Although some of the papers presented here still show the analysis of only a few pieces, five years after the RACIIC Conference we are more and more aware that if a number of analyses are carried out on one amphora type, that can lead to the identification of exceptions in the content of a specific type, and thus more systematic analyses are essential.

If until recently the only exception to this situation was Garnier's PhD, luckily the analysis of series of amphorae is becoming a more and more common habit, thanks to the possibilities offered by different projects. A first example that deserves to be cited, although it was never officially financed, is the intended CORONAM Project, which put on the table an international, interdisciplinary and systematic analysis of different amphorae types that relied on the contribution of different scholars – many present at the RACIIC Conference – that led to a first publication on Late Roman African amphorae (Woodworth *et al.* 2015). Later, national and European projects were financed which allowed the broadening of the spectrum of amphorae analysed. Among them was the RACAMed Project financed by the Spanish Ministry and directed by P. Reynolds and A. Pecci – many of the scholars who participated in this conference were involved; for Early Medieval amphorae, analyses were carried out in the framework of the NeuMed project (dir. R. Hodges); the Sicily in Transition project (dir. M. Carver and A. Molinari); and the POMEDOR project (dir. Y. Waksman) focused on Medieval pottery.

As some of the papers presented here pointed out, debate on the interpretation of the results of the analyses is still very active. However, we are now confident that when accurate checks of post depositional, sampling and laboratory contamination are carried out we can obtain important data on the content and the coating of the vessels and amphorae in particular. In this regard, the more substances we are able to identify, the more we have to pay attention to the interpretation, and we have to take care not to over-interpret the results.

To avoid this, it is important to carefully select the laboratories performing the analyses, as they must

demonstrate reliability of analyses and experience in the identification of residues and contamination, and in the interpretation of results.

A very interesting aspect that organic residue analysis has highlighted is the identification of several substances in the same amphora samples. This is certainly due to the presence of coatings and content. However in many cases it can be the results of a sum of activities (coating, use, re-use, re-cycling and discard) and we have to remember that chemical analysis cannot provide a 'stratigraphy' of the absorption. Therefore, we have to leave open the different possibilities of interpretation of a mixture of coatings (sometimes also involving a mixture of substances), contents (a single content or a mixture) and potential re-uses (again involving single substances or mixtures). Although this leads to problems in the interpretation of the original content (first content) of the amphorae which is frustrating for traditional scholars, in fact it broadens the scenarios for further investigation and shows that the reality is much more complex than the neat classifications that archaeologists would like to achieve.

Again, to solve this problem we need to integrate the research of the different specialists – taking into account the context where the amphora was last used and found by the archaeologists, the discussion of the results of the analyses with the different specialists in amphorae typology, the archaeology of the provenance areas, provenance of the amphorae, epigraphists, chemists and so on – to achieve the most accurate interpretation.

Good samples to demonstrate the methods and interpretations of organic residue analysis are those coming from shipwrecks (see above Cibecchini; Koutsouflakis). They provide situations in which, in most cases, both organic coatings and solid contents are preserved. When no solid content is preserved we usually assume that a liquid one (usually wine or oil) could have been the original content of the amphorae. The systematic study of organic coatings combined with organic residue analysis will allow to confirm the old hypothesis that when a thick pitch lining is present, usually wine or fish products are preserved in the amphora. Although some exceptions exist, this still seems to be a common pattern, but it must still be verified with a greater number of analyses. On the contrary we know that the absence of visible pitch cannot exclude the presence of wine/*garum* in an amphora.

Again shipwrecks allow us to confirm whether the analyses can identify the residues of preserved solid contents (fruit, fish, meat...) and to study the relationship between type, inscription and content, without major post-depositional contamination and degradation issues. However we must not forget that even in shipwrecks there are amphorae that were re-used and therefore we must always pay attention to the general context (type of amphora, *tituli*, provenance of the amphora, provenance of the ship, organic residues...).

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Finally, as mentioned in this publication, samples cannot be given to the ‘chemists’ as if they were a black box. Many mistakes and over interpretations are produced in this way. The collaboration among the different specialists should start from the beginning of the project, as the more fruitful results can be obtained only through a joint strategy, the discussion of the advantages and disadvantages of the different choices and through good sampling, which must be performed according to the questions raised by the project and following good practices (sampling must be ‘clean’, not bringing any contamination in the sampling phase in the field, or in the laboratory, and must provide the possibility of checking for post depositional contamination). As the title of the conference suggests, specialists need to be more interactive.

State of the question: very contrasting depending on the region

One of the initial objectives of the RACIIC congress was to try to produce a summary table with the general consensus on the contents attributed to each amphora form. In the literary ‘jungle’ in which we move every day, this type of synthetic document is more and more essential to clarify the state of the art for the reader. In the end, this was not done, for various reasons. The first is the need for consensus by at least a significant part of the scientific community and today, that is still not possible. By comparing the articles in this monograph the reader will notice that there are various points of view on the same question. To give a couple of paradigmatic examples, in the case of one of the most important families related to the commercialization of Hispanic *garum*, Dr. 7/11, *tituli picti* and contents related to grapes and watered down wine are also known; or in the case of the internationally traded Dressel 1, the wine packaging par excellence, for which the imitations from the south of Hispania and some points of the Tyrrhenian coast (Albinia) and perhaps of Sicily suggest their primary use – not their reuse – for the packaging of *salsamenta* (cf. the contributions of Beltrán, Bernal-Casasola *et al.* and Menchelli). Sometimes the different authors do not even agree on the definition and geographical origin of certain types (e.g. the Key 41, defined as a Hispanic piriform amphora or as an African cylindrical amphora, depending on the authors: see above Bernal-Casasola *et al.* vs. Bonifay). The production of this table of amphora contents (if it will ever be possible to produce such a schematization of the data obtained) is one of the pending subjects for the future and at the same time one of the conclusions of this congress: the need for an international Round Table to generate an instrument of consensual work on the contents of the main amphora series with an Atlantic-Mediterranean diffusion. First, it will be necessary to define these series, and secondly, the diverse direct (inscriptions, solid contents, organic residue analysis) and indirect criteria to identify their content (typology, productive geography of the workshops).

Another element highlighted in the various contributions presented at this congress is our diverse degree of knowledge of the palaeocontents of Roman amphorae in the different geographical areas or provinces of the Empire. The best known productive areas are those of the Western Mediterranean: Hispania (divided into the three main areas, Baetica, Lusitania, Tarraconensis, with differentiated problems), Galliae, Italy (and Sicily) and proconsular Africa with its corresponding late Roman provincial subdivision. Everybody is aware that this situation is the result of three aspects: the productive and exporting importance of these regions; the extensive historiography of the studies, inaugurated by Heinrich Dressel; and the efforts of the latest generation of archaeologists who have dedicated a good part of their respective academic careers to these topics (Fanette Laubenheimer in France is a good example of this). However, most of the Eastern Mediterranean regions are still poorly characterized, as is the case in general with the Aegean, the Anatolian coasts or the Syrian-Palestinian corridor, with honourable exceptions such as Crete and isolated cases such as Beirut (treated in this monograph by Reynolds and Woodworth) or the late Roman productions manufactured in the micro-region of Ephesus (Bezczky *supra*) or in the Black Sea (Opait *supra*). But much more problematic are other regions that we know were important in the markets and whose products traded in amphorae are completely unknown to us, as is especially the case with the well-known amphorae of *Mauretania Caesarensis*, many of them stamped; or those coming from Tingitana, which we still do not even know how to recognize typologically with any certainty, although findings from recent years are improving the situation (Bernal-Casasola *et al.* 2019).

Behind these imbalances are other important questions, such as the tacit consideration that Aegean and Eastern amphorae in general are wine containers, for which we have good indicators (*tituli* in some cases and resin coatings in others); but several articles in this book show that oil and salted fish should also be considered (see Reynolds, Opait, Koutsouflakis). Thus, efforts for the next generation of archaeologists will have to focus on two issues: qualitative questions for western Roman productions (types of fish sauces, filling in the geographic gaps); and investigations to try to scientifically verify the palaeocontents of Eastern productions, by productive micro-regions, following the example of the strategy applied to Cretan amphorae analyzed in a diachronic key by various authors (Marangou-Lerat 1995; Poulou-Papadimitriou and Nodarou 2014); or the case study of Egypt, synthesized in the pages of this book by D. Dixneuf.

What, then, does the RACIIC Congress contribute to the international debate on the palaeo-content of amphorae?

It is the reader who must answer this question after digesting the various contributions presented in

this monograph, which is important because of the contribution of international amphorology specialists. We highlight three aspects.

The first is updated regional syntheses on the main producing areas by the most internationally renowned researchers, alone or in collaboration: Lusitania (I. V. Pinto, R. Morais, C. Fabião, C. Oliveira, S. Gabriel), Hispania Citerior / Tarraconensis (R. Járrega, A. Ribera), Baetica (D. Bernal-Casasola, E. García Vargas, A. M. Sáez Romero, H. González Cesteros), Galliae (F. Laubenheimer), Tyrrhenian Italic and Sicily (S. Menchelli), Upper Adriatic (M.-B. Carre, S. Pesavento Mattioli), North Africa (M. Bonifay with J. Nacef), Egypt (D. Dixneuf), Eastern Mediterranean (P. Reynolds, T. Bezczyk) and the Black Sea (A. Opaıt).

Secondly, a battery of case studies allow us to approach the appropriate methodology. These can be used as a manual of good practices for the characterization of the amphora contents. They combine adequate sampling with archaeobotanical, archaeozoological, epigraphic, palynological and archeometric studies of a diverse nature to try to answer the question about the content of the analyzed amphora series. These case studies include one of the first Mediterranean preserved examples, such as the western Punic amphorae recovered in Corinth (A. M. Sáez Romero, T. Theodoropoulou); to the unique case of Pompeii (D. Bernal-Casasola, D. Cottica, R. Marlasca, C. G. Rodríguez Santana, E. García Vargas); passing through the rich and exceptionally well-preserved material from the underwater context of various Mediterranean areas such as the Aegean (G. Koutsouflakis), Sardinia (I. Sanna, L. Soro, C. Nervi); and on to the unique finds of the wrecks Arles-Rhône 3 in the south of France and the Bou Ferrer on the Spanish coast of Alicante (G. Piquès, N. Rovira, M. Tillier, F. Cibecchini, D. Djaoui, C. De Juan). Heuristic problems of some type or family are also dealt with, such as the case of the late Punic amphorae of the Ramon T-7.4.3.3 type (M. Luaces); or the containers with halieutic products recovered in the *cetariae* of the Murcia coast in southern Tarraconensis (A. Quevedo, M. Sternberg, J. D. Hernández-García). We hope that these works serve as inspiration to the reader when facing the analysis of the amphora contexts under study.

Thirdly, these pages demonstrate that any amphora with palaeocontent remains is a 'treasure', an exceptional find. Perhaps for any researcher focused on Classical Archaeology or Late Roman Archaeology this statement will sound strange, given the thousands of amphorae that we find daily in excavations and stored in our museums. Of these, less than a hundred have reached us with any physical content; with macro-remains and *tituli picti* only dozens; and of the latter those subjected to archeometric analysis of organic contents less than 10. Very few Roman amphorae fulfill the tetralogy: preserved inscriptions related to the content, physical remains, archeometric analysis and also, fundamentally, well studied and published results. Incredible, yes,

but equally true. Hence, one of the objectives of this International Congress of Cadiz and of the publication of these Proceedings is to raise awareness of the importance of these findings, and of their preservation and study. We hope that in the coming decades we will be able to offer a much more complex and articulated panorama of the Economic History and maritime traffic of Rome, aspects for which amphorae play a strategic role.

Finally, a fundamental aspect that RACIIC has highlighted is the need for interdisciplinarity.

Indeed, one of the important lessons of this congress is the confirmation that in order to advance the research it must be interdisciplinary. In the case of semi-solid or solid products (salted fish, *altec*, meat, olivae, fruits...) the research will have to be carried out by specialists of amphorae typologies, epigraphy, and the corresponding specialists (ichthyologists or more broadly archaeozoologists, carpologists...). In all cases the ideal situation would be to work with chemists, to carry out organic residue analysis to investigate the liquid products (oil, wine, *garum*, organic contents that are not visible, preserving agents such as vinegar...) that could be the content itself or were used to better preserve the solid content.

A theme that was not mentioned in the conference, but of which we are all aware is that all the studies of the content should be coupled with the analysis of the provenance/origin of the amphorae. This also implies the involvement of specialists (geologists, archaeometrists). We consciously avoided this at RACIIC because of the very wide research on the subject that would have gone beyond the time available at the conference, but we are fully aware that only the combination of provenance and content will allow more accurate investigations of the themes of use and re-use of amphorae and their original content.

Cádiz – Aix – Barcelona – Toulon, May 2021
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