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African amphora contents: an update

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Abstract: This paper aims to update the previous syntheses made by the author in 2004 and 2007 about the contents of African amphorae. Firstly, there is a revision of the different arguments providing information on these contents (typology, epigraphy, distribution, stoppers, macro-remains, archaeometry), and second, an updating of the different hypotheses relating to contents (oil, fish products and wine) by types. The conclusion is that very little progress has been made for 15 years, and the hypotheses about contents can still be divided into three categories: certain (oil for types Africana I and Tripolitana I/III; *salsamenta* for type Africana II C; wine for imitations of types Dressel 2/4, Gauloise 4 and LRA 1); controversial (amphorae of Punic tradition, early Roman types, Africana II and III); and completely conjectural (5th to 7th century types). The author calls for the launch of an ambitious programme of chemical analyses in order to reach a better understanding of the foodstuffs transported in the African amphorae from the mid 2nd century BC to the end of the 7th century-beginning 8th century AD.

Key words: Africa; amphorae; oil; wine; *salsamenta*; trade.

1. Introduction

While the African amphora typology and chronology are becoming better understood, the same cannot be said of their contents. Africa is perhaps the region of the Roman world where amphora contents remains a major problem.

During the fifteen years after the work carried out on African amphorae by Fausto Zevi and André Tchernia in 1969, there was little doubt about their content. Their large distribution overseas was supposed to provide evidence of the development of olive cultivation in Africa under the Antonine dynasty (Carandini 1970). Therefore olive oil was considered to be the content of most of these containers, first at Ostia for the 2nd-4th century types (Panella 1973; Manacorda 1977), and then in Catalonia for the latest types of the 5th to 7th century (Keay 1984).

Nevertheless, the idea of a single content was not entirely accepted among the specialists. In 1969 it was clear to Fausto Zevi and André Tchernia that two different amphora types produced in the same workshops could have meant two different contents, the largest amphorae (Africana II) being probably devoted to olive oil, and the smaller ones (Africana I) to *garum* or salted fish (Zevi and Tchernia 1969: 185–187). On the other hand, Robert Lequément's work during the 70s had drawn attention to the pitch lining of some African amphorae which was from a general point of view totally incompatible with an oleaginous content. As a matter of fact, such a pitch lining was present inside numerous Africana II and III amphorae (Lequément 1975 and 1976). Lastly, a chemical analysis programme undertaken in 1980 by André Tchernia and chemist Françoise Formenti made it possible to reverse the initial hypothesis, and to determine that Africana I was intended for the shipping of olive oil (due to traces of fat acid), while Africana II (which did not show fat acid traces, but traces of pitch) probably transported another foodstuff, perhaps salted fish products.

During the 80s and 90s, different research schools have developed, some specialists remaining faithful to olive oil as the content of most African amphorae (Keay 1984; Peacock and Williams 1986), others leaning more towards a strict separation between the contents according to typology (Sciallano and Sibella 1991), yet others adopting a prudent approach suggesting a possible interchangeability of the contents (Panella 1982; Laubenheimer 1990).

In the last 25 years I have tried several times to address this issue, taking into account all the available arguments, archaeological and archaeometric (Ben Lazreg *et al.* 1995; Bonifay 2004, 2007 and 2016). Recent data, as well as a new scientific approach led by a young generation of researchers, might justify this attempt at a provisional updating (Figure 1).

2. Current debates

2.1. Amphora shape

Is the typology indicative of the content? I would be inclined to follow Bernard Liou when he asserts that 'il faut évidemment croire dur comme fer aux principes de base: qu'il y a des amphores à vin, des amphores à huile et des amphores à saumure que distingue leur forme' (Liou 1988: 172). If the African potters imitated the Dressel 2/4, Gauloise 4 or MR 1, that is probably because the African producers wished to package their own production of wine in such containers (Figure 4.61-63). This assertion, verifiable for the African imitations of non-African types, is perhaps also applicable to most African amphorae of Punic tradition and Roman-African typology. This is not very far from our current notion of intelligent packaging. What our logistics specialists propose to do with nanotechnologies, the ancients tried to do through the amphora shape, the stamps and the *dipinti*...

Fig.	Type	Traces of pitch	Archaeological arguments	Archaeometry	Possible content
1	Van der Werff 1	▪			<i>salsamenta?</i> wine?
2	Van der Werff 2	▪		traces of wine	<i>salsamenta?</i> wine?
3	Van der Werff 3	▪		traces of wine	<i>salsamenta?</i> wine?
4	Schöne-Mau XL	?	not attested at the Monte Testaccio; long hollow spike		<i>salsamenta?</i>
5	Hammamet 1	□	not attested at the Monte Testaccio		<i>salsamenta?</i> wine?
6	Hammamet 1E	□	attested at the Monte Testaccio		oil?
7	Hammamet 2	□			?
8	Hammamet 3	□			?
9	Tripolitaine II	□	not attested at the Monte Testaccio; coastline and inland workshops		<i>salsamenta?</i> wine?
10	Benghazi LR 7	?			?
11	<i>Leptiminius</i> II	▪	not attested at the Monte Testaccio; long hollow spike		<i>salsamenta?</i>
12	Ancient African	□		traces of oil?	oil? interchangeable?
-	Dressel 26	□			? (oil ?)
13	Carthage EA IV	▪	long hollow spike		<i>salsamenta?</i>
14	<i>Leptiminius</i> I	?	fish macro-remains; long hollow spike		<i>salsamenta?</i>
15	<i>Uzita</i> Pl. 52, 10	□	not attested at the Monte Testaccio; long hollow spike		<i>salsamenta?</i>
16	<i>Ostia</i> LIX	□	cork stopper		olives? <i>salsamenta?</i> wine?
17	<i>Ostia</i> XXIII	□	attested at the Monte Testaccio; ceramic stopper; shape close to type <i>Africana</i> I		oil?
18	<i>Africaine</i> II pseudo-tripolitanian	?	inland workshops; attested at the Monte Testaccio?		oil?
19	Bonifay 16	□	attested at the Monte Testaccio; shape close to type <i>Africana</i> I		oil?
20	Bonifay 17	?			?
21	Station 48 piazzale delle Corporazioni	▪			<i>salsamenta?</i> wine?
22	<i>Africaine</i> I	□	attested at the Monte Testaccio; ceramic stopper	traces of oil	oil
23	<i>Africaine</i> II A	▪	rare at the Monte Testaccio; cork stopper	no traces of oil anchovy DNA	<i>salsamenta?</i> wine?
24	<i>Africaine</i> II B	▪	rare at the Monte Testaccio		<i>salsamenta?</i> wine?
25	<i>Africaine</i> II C	▪	coastline workshops; lead labels with trident; fish macro-remains?		<i>salsamenta?</i>
26	<i>Africaine</i> II D	▪		no traces of oil	<i>salsamenta?</i> wine?
27	Tripolitaine I	□	attested at the Monte Testaccio		oil
28	Tripolitaine III	□	attested at the Monte Testaccio		oil
29	<i>Africaine</i> III A (= Keay 25.1)	▪		no traces of oil, chemical marker of wine	wine?
30	<i>Africaine</i> III B (= Keay 25.3)	▪		no traces of oil, no traces of wine, fatty acids?	<i>salsamenta?</i>
31	Keay 25 V	?			? (oil ?)
32	<i>Africaine</i> III C (= Keay 25.2)	▪		no traces of oil, chemical marker of wine?	<i>salsamenta?</i> wine? interchangeable?
33	<i>spatheion</i> 1	□	no traces of pitch (ex.: Pisa); olive pits (ex.: Dramont E wreck); fish macro-remains (ex.: Tarragona)		interchangeable? oil, olives, <i>salsamenta</i> , wine?
34-37	<i>spatheion</i> 3	▪	dipinti		<i>garum?</i>
38	Keay 27	□	inland workshops?		oil?
39	Keay 36	□	inland workshops?		oil? wine?
40	Keay 59/8B	□	inland workshops		oil?

Fig.	Type	Traces of pitch	Archaeological arguments	Archaeometry	Possible content
41	Keay 35A	□			oil?
42	Keay 35B	■	coastline workshops; fish macro-remains; attested in fish-salting factories		salsamenta?
43	Keay 39	□			? (oil?)
44-46	Keay 55-56-57	□		no traces of oil in Keay 55	? (salsamenta? wine?)
47	Keay 64	?			?
48	Keay 3/5	□			? (oil?)
49	Keay 40	?	inland workshops?		? (oil? wine?)
50	Keay 41	?	inland workshops?		? (oil? wine?)
51	Keay 62R	?			?
52	Keay 62Q / Albenga 11/12	?	ceramic stopper		? (oil?)
53	Keay 62A	□		traces of oil	? (oil?)
54	Bonifay 47	■			? (salsamenta? wine?)
55	Keay 61C,	□			? (oil?)
56	Keay 61 A/D	?			?
57	Keay 8A	■			?
58	Keay 34	?			?
59	Keay 50	?			?
60	'orlo a fascia'	?			
61	Schöne-Mau XXXV	■	imitation of wine amphora		wine
62	pseudo-Dressel 2/4	?	imitation of wine amphora		wine
-	Benghazi MR 1	?	imitation of wine amphora		wine
63	Dressel 30	■	imitation of wine amphora		wine
64	Keay 1B	■	imitation of wine amphora?		wine? salsamenta?
-	Carthage LRA 1	?	imitation of wine amphora		wine
65	Globular 3 ('Castrum Perti')	?	imitation of wine amphora?		wine?
66	Bonifay 57	?			garum?
67	Bonifay 58	?			garum?
68	Augst 73	?			ointment?

■: traces of pitch; □: no traces of pitch.

FIGURE 1. AFRICAN AMPHORA CONTENTS. SUMMARY OF HYPOTHESES.

2.2. Stamps

Stamps rarely provide information on the content. Those present on African amphorae generally mention *tria nomina*; sometimes in Tripolitania the social status of the individual or the imperial status of the workshop; and sometimes in Mauretania Caesariensis, Zeugitana and Byzacena, the name of the city where a workshop is located. Nevertheless, one case was recently evidenced at *Leptiminius* of a stamp likely to inform us about the content: A series of stamps mentioning the city name *LEP(timinius)*, are decorated with vine scrolls (Mattingly *et al.* 2011: 217 and fig. 6.11). D. Mattingly and D. Stone interpret this stamp as a possible evidence for a wine content in amphorae *Africana II D* and *Africana III* (Figure 3.26 and 29), on which this stamp is printed.

2.3. Dipinti

Dipinti which are rare on African amphorae, rarely provide information on content (this is true of other types of amphorae too: Martin-Kilcher 2011: 417). One exception is represented by two *Tripolitana I* amphorae

(Figure 3.27) from Pompeii, which bear the wording *shmn* – 'oil' in Punic (Panella 1977: 145). Normally, the *dipinti* on the Tripolitanian amphorae from the Monte Testaccio (Aguilera 2007) consist of *tria nomina* abbreviations, sometimes followed by two letters mentioning the social status of the person (the *negotiator?*), and below by a number indicating the quantity of oil transported. Capacity is also specified on graffiti that sometimes replace the *dipinti* (Liou and Silvino 2005: 727, PSG 11). In two cases, the warehouse at the port of departure – *Hadrumentum* – is also mentioned on *Africana II* amphorae (Torres 2007). For that reason, one may ask whether the mention of a specific content or a specific origin is intended to warn the consumer that this content (or origin?) is not the usual one according to the amphora shape. This is the hypothesis put forward by André Tchernia.

Following this assumption, a possible example of unusual content is given by the wording *olei* on an amphora *Africana II* from Ostia, which led us to believe, erroneously, that this type was the normal container for olive oil from

Roman Africa (Zevi and Tchernia 1969: 187). An example of unusual origin is perhaps illustrated by the *dipinti* on *spatheia* type 3 (Figure 3.34-37) discovered in Egypt, where the content — *garum* — is associated with names of monasteries. Among these latter, at least one — Saint Menas — can only be located in Egypt. We don't know if these African containers were reused for the packaging of Egyptian fish sauce, or if the African *garum* was distributed through Egyptian monasteries (Fournet and Pieri 2008; see also J.-L. Fournet in this volume).

More difficult to solve is the case of the *dipinti* on amphorae Ostia LIX in Pompeii (Figure 2.16), in particular the wording *TAVR* previously translated (*uinum*)*Taur(omenitanum)* — wine from Taormina (see most recently Peña 2007). This hypothesis has to be rejected, because the type Ostia LIX, also named 'Type 2020' (Scotti 1984: Pl. 160), is definitely an African amphora, not a Sicilian one. Instead of *Tauromenium*, the name of *Tauraca*, an alteration of *Thabraca*/Tabarka was recently proposed, as a working hypothesis. As the other abbreviations attested on the same type in Pompeii, *MOL*, *VIR* et *STR*, seem to refer to different kinds of olives, (*oliuae*) *MOL(lles)*, *VIR(ides)*, and *STR(ictiuae)*, the wording *TAVR* could have a geographic significance, in relation to the preparation of the olives — (*olivae*) *TAVR(acenses)* (Bonifay *et al.* 2015). Even if this set of assumptions should prove to be correct, we don't know whether olives were the usual content of Ostia LIX, or if it was a particular content signalled by the *dipinto*, or even the reuse of the amphorae. An amphora of the same type discovered in the House of Menander in Pompeii carries a curious *dipinto* *N?AP/OLEVM*. In order to explain the traces of moringa oil evidenced by chemical analyses in four amphorae Ostia LIX found in Arles (see below), it has been recently proposed to develop *NAP* as *Napata*, a city of Upper Egypt where moringa growing is attested from the Roman period onwards (Djaoui, Garnier and Dodinet 2015). In this case the *dipinto* could obviously signal the reuse of the container.

Finally, it is more common to find *dipinti* with content information on amphorae of Punic tradition. Several amphorae from Pompeii, *Herculanum* and Rome, derivatives of type Van der Werff 1, have *dipinti* (Martin-Kilcher 1999: fig. 10) mentioning fish products (*hallec*, *muria*) that are for the moment difficult to define more precisely (Martin-Kilcher 2011: 417).

2.4. Lead labels

Lead labels seem to be characteristic of African amphorae and have been discovered wrapped around handles of Africana II C amphorae (Figure 3.25) in the Annaba wreck. Robert Lequément demonstrated that the *officina(e)* mentioned on these lead labels might be interpreted as fish-salting factories, a hypothesis also reinforced by the representation of a trident on one of these labels (Lequément 1975). Other lead labels have been found on some other wrecks, always associated with a cargo of Africana II C (e.g. on the wreck of Pampelonne: Lequément 1976).

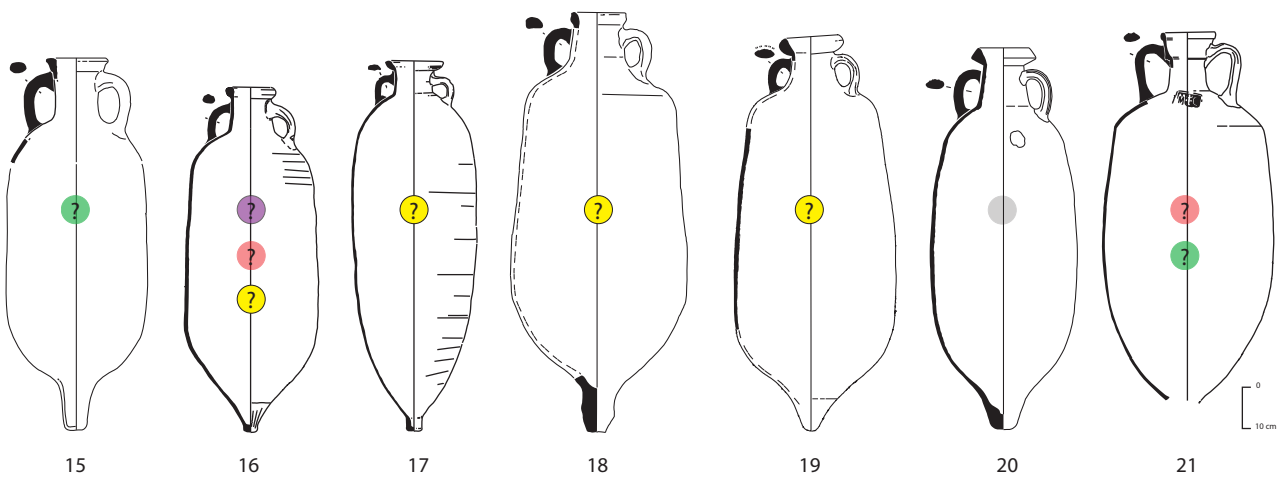
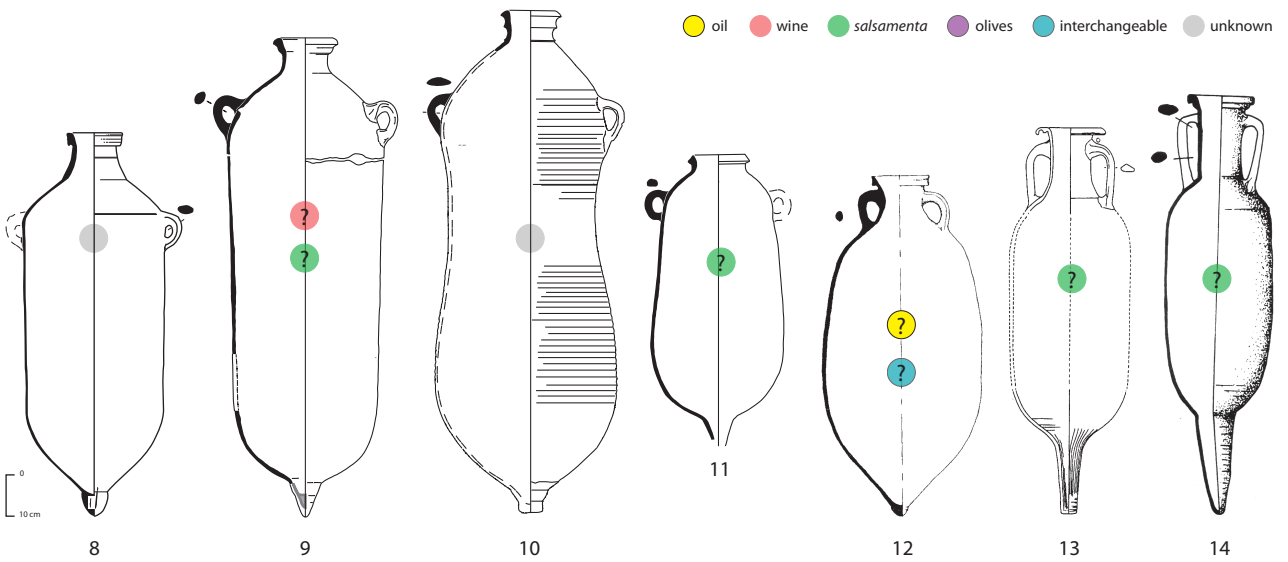
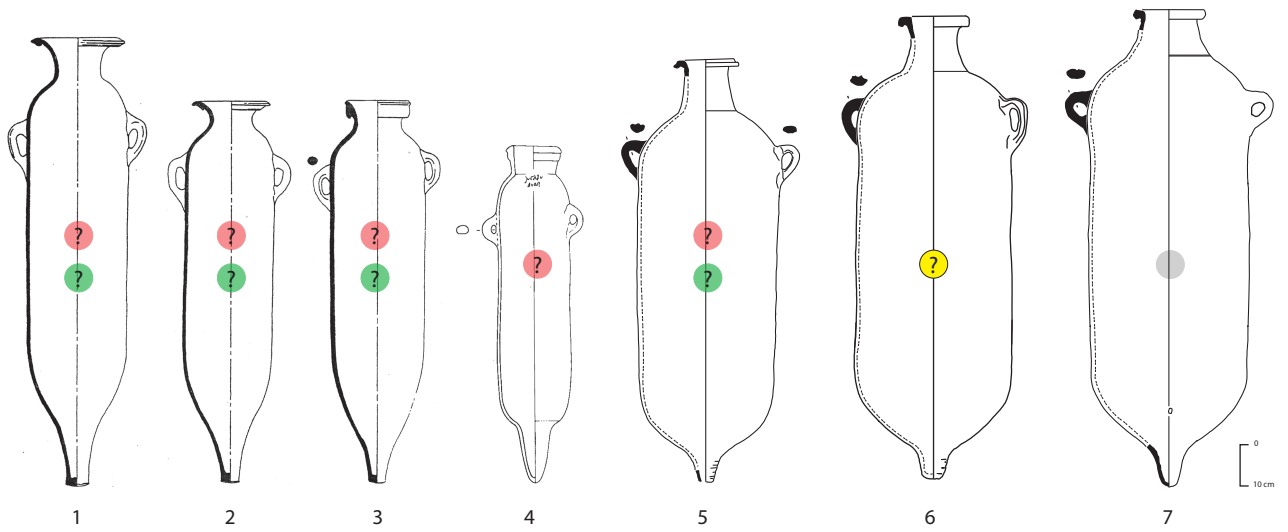
2.5. Workshop location

Using workshop location as a clue to content is difficult in *Africa proconsularis* because the workshops are not located close to foodstuff production centres, but close to the ports in charge of the distribution of these foodstuffs. Thus, at Salakta, *Leptiminus* and Nabeul amphorae for the distribution of oil, *salsamenta*, and wine were produced, products that were not necessarily produced on the territory of these cities (for Salakta and Nabeul: Ben Moussa, Bonifay and Nacef forthcoming; for *Leptiminus*: Mattingly *et al.* 2011). Some exceptions are reported in Byzacena, for example the workshops of the South side of the sebkhra Sidi el-Hani, which produced the so-called 'pseudo-Tripolitanian' Africana II amphorae (Figure 2.18), the content of which was certainly not fish products. The situation is different in Tripolitania, at least in the hinterland of *Oea* and *Lepcis Magna*, where the workshops seem to be linked with agricultural properties, as shown by the Tripolitana III amphorae (Figure 3.28) produced in the Tarhuna plateau region (Ahmed 2019). One remaining problem is that amphorae Tripolitana II (Figure 2.9) were produced not only on the coastline, West of *Lepcis Magna* (Capelli and Leitch 2011) and at *Oea* (Panella 1973: 564), but also in the Tarhuna plateau region (Ahmed 2019). Should we think about two different contents (*salsamenta* and wine) for the same amphora type? Workshop location was also used in order to assign a wine content to the amphorae Van der Werff 2-3 (Figure 2.2-3) produced in the centre of Jerba Island (Fentress 2001).

2.6. Distribution

There are very few new elements in this field. We can just confirm the primacy of Africana I and Tripolitana I/III

FIGURE 2. AFRICAN AMPHORA CONTENTS. 1: VAN DER WERFF 1 (RAMON 1995: T7421); 2: VAN DER WERFF 2 (RAMON 1995: T7422); 3: VAN DER WERFF 3 (RAMON 1995: T7411); 4: SCHÖNE-MAU 40 (PANELLA 2001; POMPEII); 5: HAMMAMET 1 (BONIFAY 2004; *PUPPUT*); 6: HAMMAMET 1D (BONIFAY 2004; *PUPPUT*); 7: HAMMAMET 2 (BONIFAY 2004; *PUPPUT*); 8: HAMMAMET 3 (CAPRINO 1999; TIVOLI); 9: TRIPOLITAINE II (BONIFAY 2004; *PUPPUT*); 10: BENGHAZI LR7 (BONIFAY, CAPELLI, MUÇAJ 2010; *LEPCIS MAGNA*); 11: *LEPTIMINUS* II (BONIFAY 2004; MARSEILLE); 12: ANCIENT AFRICAN (SCIALLANO AND SIBELLA 1991; CAMARA 2 WRECK); 13: CARTHAGE EA IV (MARTIN-KILCHER 1999; CARTHAGE); 14: *LEPTIMINUS* I (OPAÏT 2000; *LEPTIMINUS*); 15: *UZITA* PL. 52, 10 (BONIFAY 2004; ROUGGA); 16: *OSTIA* LIX (BONIFAY *ET AL.* 2015; POMPEII); 17: *OSTIA* XXIII (EXCOFFON AND PELLEGRINO 2015; FRÉJUS); 18: AFRICANA II 'PSEUDO-TRIPOLITANIAN' (BONIFAY 2004; EL JEM); 19: BONIFAY 16 (BONIFAY 2004; *PUPPUT*); 20: BONIFAY 17 (BONIFAY 2004; *PUPPUT*); 21: STATION 48 PIAZZALE DELLE CORPORAZIONI (BONIFAY 2004; *PUPPUT*).



amphorae (Figure 3.22 and 27-28) at Monte Testaccio, which was the major dump for oil amphorae in Rome at least until the mid 3rd century AD. Along with these three dominant types, some other African amphorae are also present. Some of them can be considered as exceptions, either in regard to their content (following the example of the Africana II amphora from Ostia with a *dipinto olei*), or in regard to the place where they were discarded, if we accept that amphorae for fish products or wine could have been exceptionally dumped at the Monte Testaccio.

Among these exceptions, I would place the types Africana II A, II B, II C and II D (Figure 3.23-26), as well as the type Carthage EA IV (Figure 2.13), generally quite rare. Nevertheless, one might note that a greater proportion of Africana II A has been recently evidenced in contexts of the first half of the 3rd century (Revilla 2010: 399–400). On the other hand, the presence at Monte Testaccio of some minority types could imply that they were devoted to the transportation of olive oil. This could be the case for the Africana II ‘pseudo-Tripolitanian’ (Figure 2.18) (Revilla 2007: fig. 15, no.1-3, rather than Africana II D), and Hammamet 1E (Figure 2.6) (Revilla 2007: fig. 3, no.16-17), which differs from the other variants of the same type by its greater size (Bonifay 2004: 96 and fig. 49). Lastly, it is particularly interesting to note that among the two types attributed to the early production of North-Western Zeugitana, Ostia LIX and Ostia XXIII (Figure 2.16-17), only the second one is attested in contexts of the 2nd century at Monte Testaccio (Revilla 2007: fig. 3.9-14, and fig. 14.2-3, rather Ostia XXIII than Ostia LIX). This clue for a difference of content for the amphorae Ostia LIX and XXIII is supported by observations made on the cargo of the wreck ‘of the Columns’ at Camarina, where the amphorae Ostia LIX were sealed with a cork stopper, while the containers Ostia XXIII without traces of pitch (see below) were sealed with a ceramic stopper (Bonifay, Franco and Cacciaguerra 2016: 391–392), an observation that gives to the latter type another characteristic of a container for oil, and justifies its presence at Monte Testaccio.

2.7. Modes of sealing and opening the amphorae

The distinction between ceramic and cork stoppers was investigated between 2004-7. The former are mainly associated with Africana I (Bonifay 2004: 467 and fig. 263, no.1), and some late types, such as amphora type

Albenga 11/12 (Figure 3.52) from the wreck of La Palud (Long and Volpe 1998: fig. 297, no.80). The latter are rather associated with Africana II and III (wrecks of Giglio Porto and Cap Blanc, see Parker 1992: 193 and 99), *spatheion* 1, and Keay 35B (Figure 3.33 and 42) (wreck of Dramont E, see Santamaria 1995: 125). In spite of some contradictory data, the previous example of the Camarina wreck shows that the mode of sealing the amphorae could help distinguish a possible difference of content in two similar types of amphorae. On the other hand, the criterion of the mode of opening the amphorae (Bonifay 2004: 467–470) needs further discussion and analysis.

2.8. Macro-remains

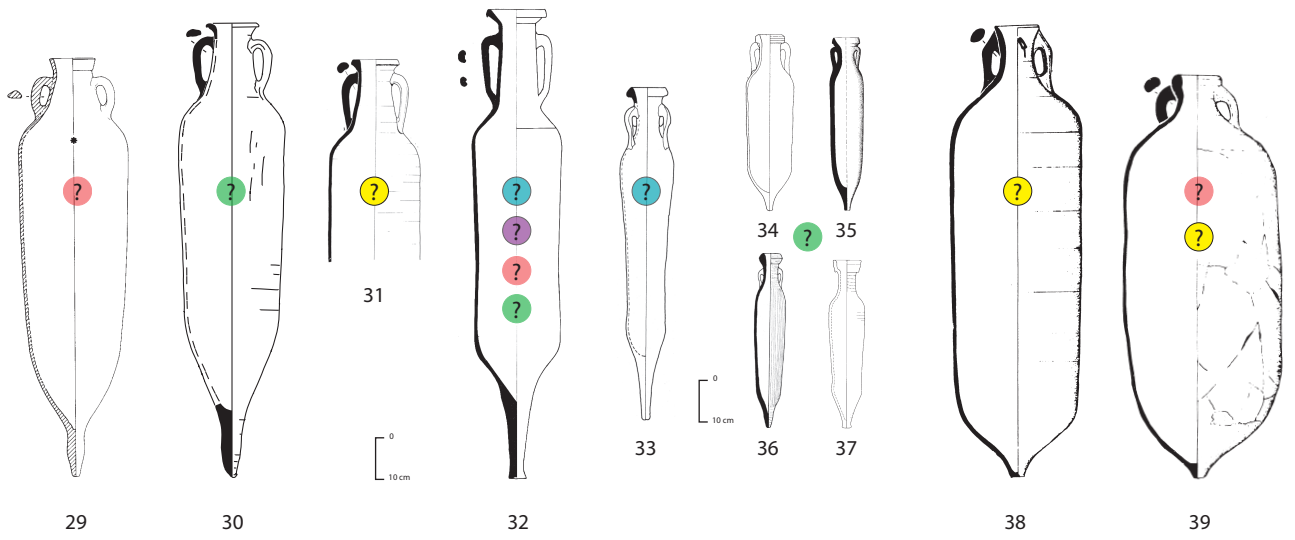
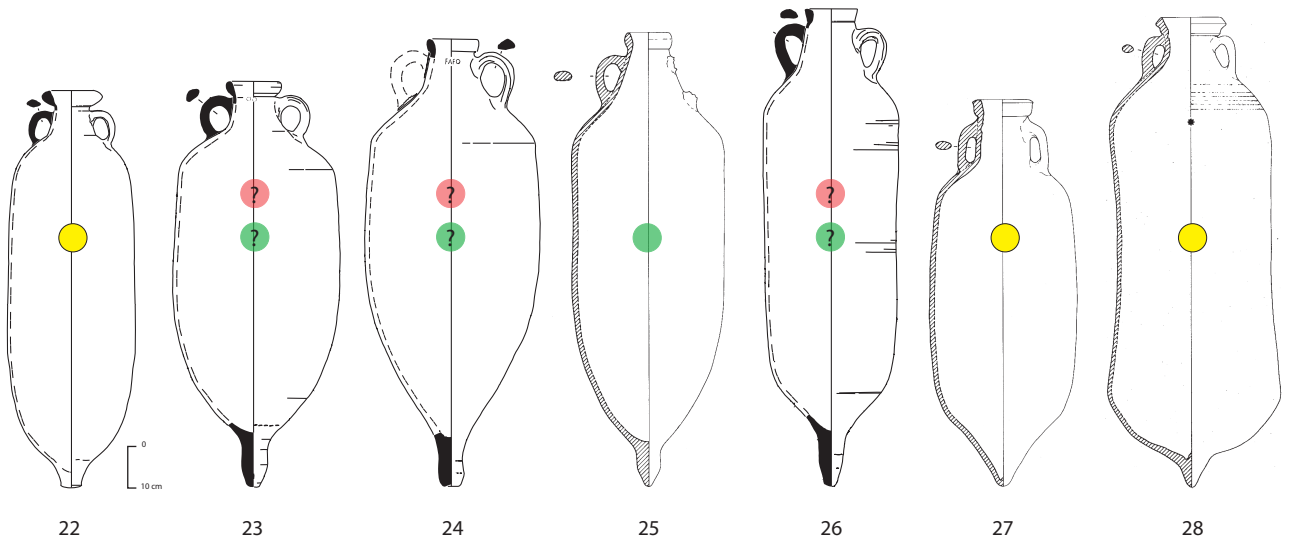
The most frequently reported macro-remains in African amphorae coming from underwater excavations are shells and crustaceans, but it is not possible to know whether they are evidence of the content or traces of colonization of the amphora by these animals after the sinking of the ship (see also Koutsouflakis in this volume). Fish remains, generally stuck to the pitch, are a more reliable testimony of the original content. Less frequently mentioned in the literature, these remains are more specifically observed in Africana II amphorae, in most cases without specification of the variant (Bonifay 2007: fig. 3a, table drawn up after Parker 1992). Olive pits are also reported in amphorae Africana II, III C and *spatheia*. Lastly, a neck of type Africana II D, coming from the wreck of Pointe de la Luque B, with grape pips glued to the pitch, could suggest a wine content (Bonifay 2004: fig. 262.4); nevertheless, we must also take account, following Stefanie Martin-Kilcher, of more complex products mixing fish sauce and wine (Martin-Kilcher 2011: 420).

2.9. Pitch

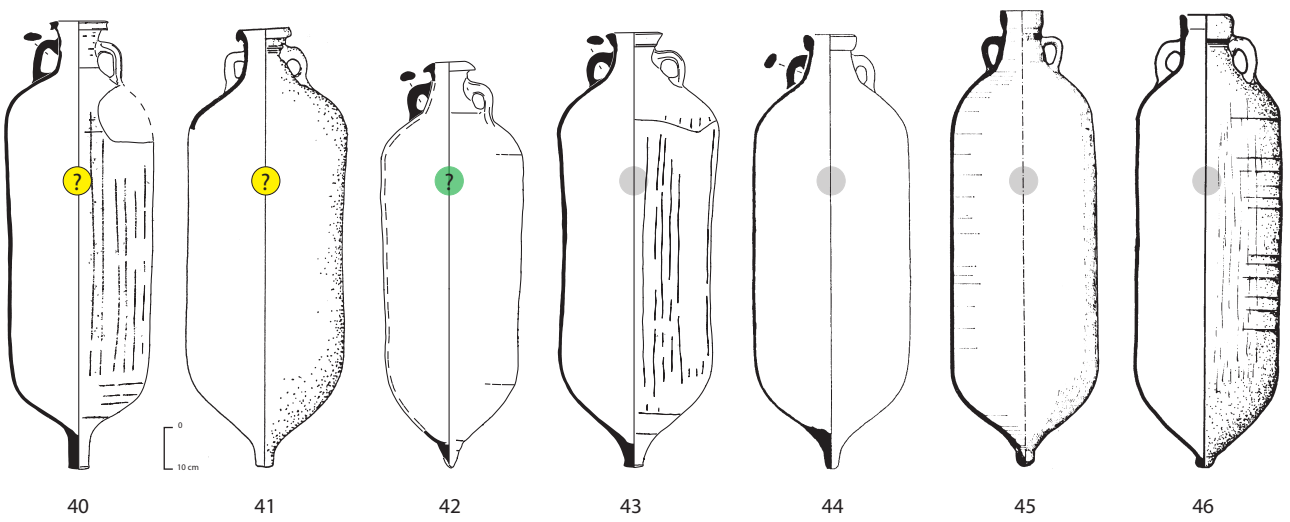
New data on this issue are abundant, and suggest, on first reading, to a complete reversal of previous hypotheses (see also Garnier and Pecci in this volume).

Pitch was regarded ten years ago as the cornerstone of the argumentation on (African) amphora contents. As a matter of fact, if we examine amphorae coming from underwater excavations or port silting — it is preferable to deal with anaerobic contexts to get the pitch conserved — we can see with the naked eye that

FIGURE 3. AFRICAN AMPHORA CONTENTS. 22: AFRICAINE I (BONIFAY 2004; PUPPUT); 23: AFRICAINE II A (BONIFAY 2004; PUPPUT); 24: AFRICAINE II B (BONIFAY 2004; PUPPUT); 25: AFRICAINE II C (PANELLA 1973; OSTIA); 26: AFRICAINE II D (BONIFAY 2004; PLANIER VII WRECK). 27: TRIPOLITANA I (PANELLA 1973; LEPICIS MAGNA); 28: TRIPOLITANA III (PANELLA 1973; LEPICIS MAGNA); 29: AFRICANA III A (= KEAY 25.1) (PANELLA 1973; THAENAE); 30: AFRICANA III B (= KEAY 25.3) (BONIFAY 2004; ANTIBES); 31: KEAY 25 V (KEAY 1984; TARRAGONA); 32: AFRICANA III C (= KEAY 25.2) (JONCHERAY 1975; WRECK DRAMONT E); 33: SPATHEION TYPE 1 (SANTAMARIA 1995; WRECK DRAMONT E); 34: SPATHEION 3A (VILLA 1998; UDINE); 35: SPATHEION 3B (BASS ET AL. 1982; YASSI ADA WRECK); 36: SPATHEION 3C (GAGNIÈRE 1965; SAINT-ÉTIENNE DE CANDAU); 37: SPATHEION 3D (BIFFINO ET AL. 1998; SAN GIUSTO); 38: KEAY 27 (KEAY 1984; TARRAGONA); 39: KEAY 36 (KEAY 1984; CAN SAMARRUGA); 40: KEAY 59/8B (BONIFAY, CAPELLI AND MOLINER 2011; MARSEILLE); 41: KEAY 35A (OΠΑΙΤ 1997-98; TOMIS); 42: KEAY 35B (BONIFAY 2004; DRAMONT E WRECK); 43: KEAY 39 (BONIFAY, CAPELLI AND MOLINER 2011; MARSEILLE); 44: KEAY 57 (SCIALLANO AND SIBELLA 1991; FOS-SUR-MER); 45: KEAY 56 (PALOL 1987; FORNELS); 46: KEAY 55 (OΠΑΙΤ 1997-98; TOMIS).



● oil ● wine ● *salsamenta* ● olives ● interchangeable ● unknown



some of them bear traces of pitch, while others do not. Many similar observations were made during field work (Bonifay 2004: 464, fig. 260; Bonifay 2007: 12, fig. 3, both tables drawn up after Parker 1992), the best example being that of the Dramont E wreck, where amphorae type Keay 35B (Figure 3.42) show traces of pitch, while amphorae type Keay 35A (Figure 3.41) do not. Another survey was carried out *a posteriori*, in 1993, in the storerooms of the French Department of maritime and underwater excavations (DRASSM), with the observation of more than 200 complete or fragmentary African amphorae, stating that no Africana I amphorae had traces of pitch, while most of the Africana II, III and late types (Keay 35B, 62) did (Bonifay 2004: 465–467, fig. 261; for a complete inventory, see Ben Lazreg *et al.* 1995: 133–135). Following this survey, I proposed to assign content other than olive oil to all the African containers showing traces of pitch – that is to say the majority.

Archaeometry (see below) has provided the evidence to contest this model. Indeed, the analysis by Nicolas Garnier of a series of samples in 2004 (Garnier, Annexe, Analyse du contenu d'amphores africaines, in Bonifay 2007: 25–29) showed traces of pitch together with traces of oil in one African amphora Keay 62A (Figure 4.53) coming from La Palud wreck, even though no traces of pitch were visible to the naked eye. This observation, considered as an exception at the time, was explained by the nature of oil transported in this amphora (fuel for lamps) and/or a possible reuse of the amphora (Garnier in Bonifay 2007: 29). This first reassessment of the principle governing the characterization of the amphorae devoted to the transportation of olive oil was followed by many others over the last few years. The analysis by Kerlyne Romanus of samples collected on Eastern amphorae from Sagalassos, carried out in parallel with a series of *ex novo* experiments, showed that pitch is fully compatible with oil (Romanus *et al.* 2009). The same results were obtained by Alessandra Pecci on amphorae from the port of Classe, as well as on Medieval ceramics (Pecci *et al.* 2010; Pecci 2009). These results challenge the argument that traces of pitch exclude oil as the content of an amphora (Pecci and Cau 2010; see also Garnier and Pecci in this volume).

Nevertheless, faced with this new data, we must keep a 'cool head' (Bonifay and Tréglià 2010: 1037). The chemists' viewpoint is not the same as the archaeologists', or more exactly chemists can see things that archaeologists cannot

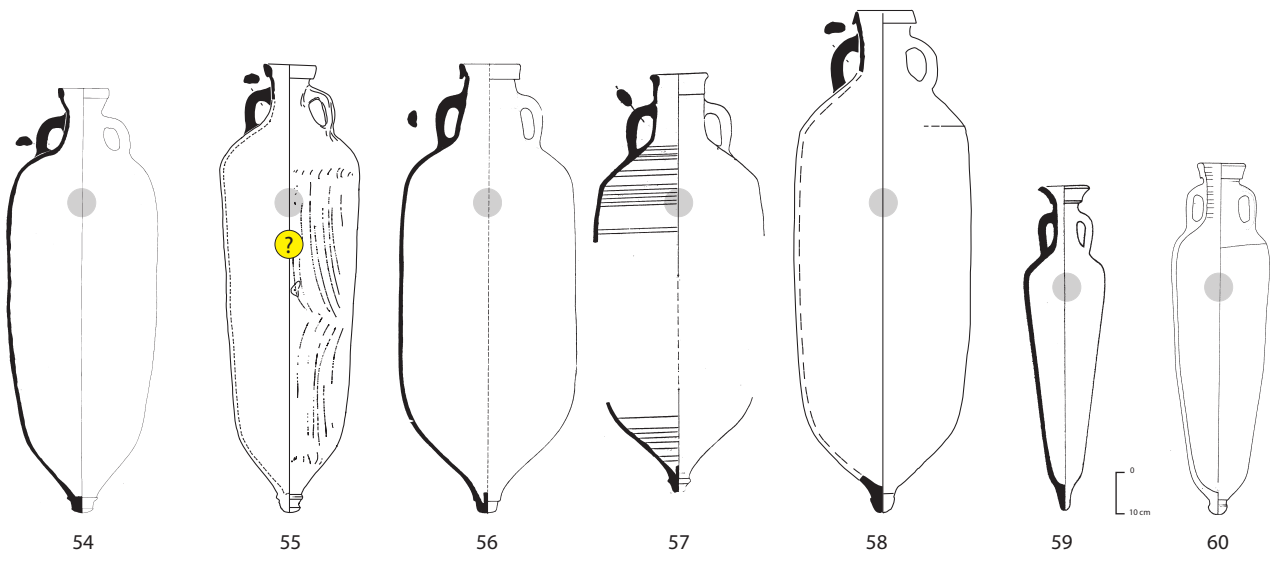
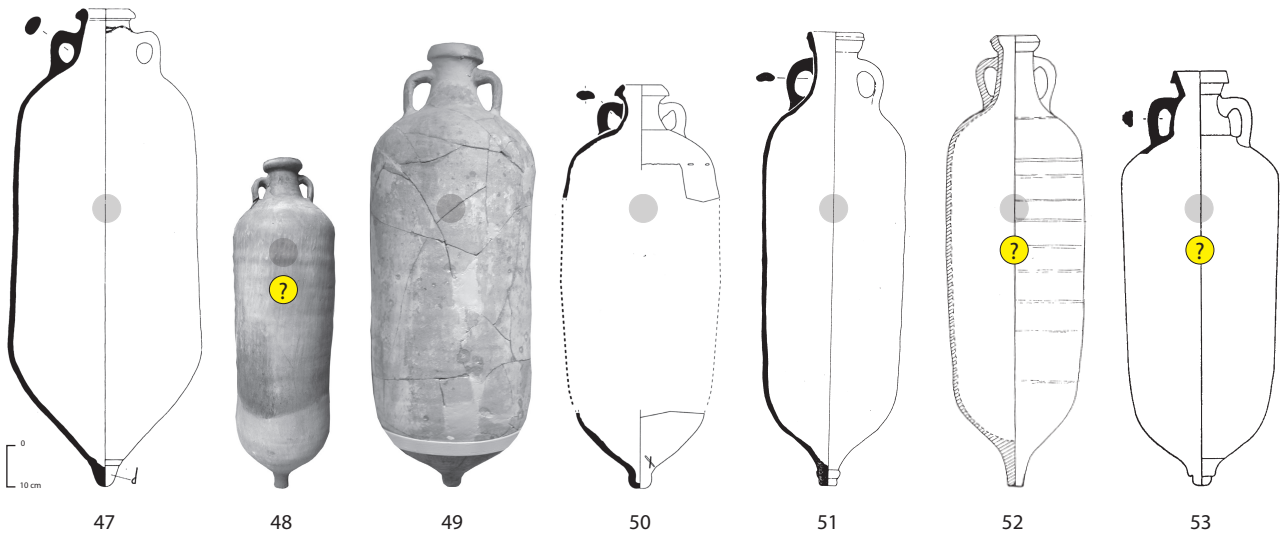
see. Nicolas Garnier perfectly summed up the situation after having analysed Spanish amphorae Dressel 20 together with amphorae Africana I, all of them coming from underwater excavations in the river Rhone. He could demonstrate that all these amphorae contained traces of olive oil, and almost all of them traces of pitch as well. But, even if these amphorae were coming from an anaerobic context, no traces of pitch were visible to a naked eye. He explained this phenomenon by the dissolving action of oil, which was deeply impregnated in the ceramic material, and the disappearance of the pitch from the internal surface of the container (Garnier *et al.* 2011: 411: 'comme la poix est poussée à l'intérieur des parois, il est normal de n'en retrouver aucune trace visible, ou exceptionnellement'). The macroscopic observation of a lack of pitch, even if proved to be false from a chemical point of view, can help to identify the content of an amphora – in this case possibly oil.

2.10. Archaeometry

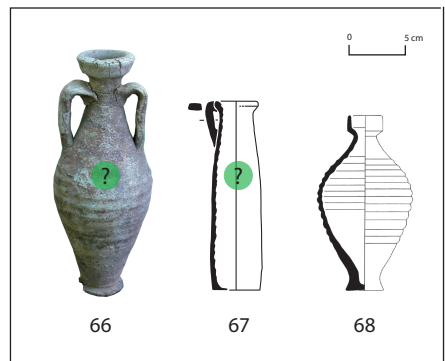
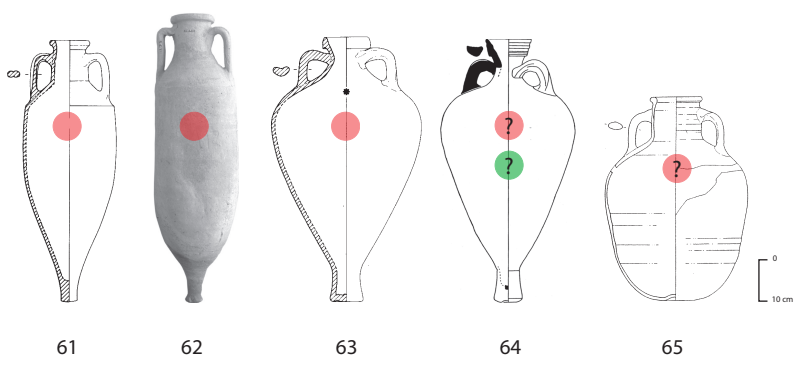
The development of archaeometry also helped with the determination of the contents themselves (see Garnier and Pecci in this volume).

A series of surveys highlighted some unsuspected contents. We have already discussed the moringa oil detected in the amphorae *Ostia* LIX (Figure 2.16) from Arles (see above). But this is also the case for the marker of ricinoleic acid found in the African amphorae from storeroom 17 of the port of Classe, burnt at the end of the 5th century, composed of late variants of *spatheia* type 1 and large-sized amphorae of unknown typology (Classe/Magazzino 17, type 1, probably not Keay 57, 62Q and 61A, see Pecci *et al.* 2010: table 2). This marker was interpreted as the evidence for the transportation of castor oil in all these amphorae (Pecci *et al.* 2010). This kind of oil is known for having been used as fuel for lamps in Egypt, and as body ointment, but traces of production in North Africa are lacking. Considering that the same marker was found in amphorae of different typologies and origins (for example in a LRA 2 from Lesbos, where it was interpreted as a reuse of the container), I wonder whether ricinoleic acid provides evidence for the content or if castor oil was used during the preparation of the container, as an antiseptic (in the same way as the sulphur that was detected in some Africana I amphorae, see Garnier *et al.* 2011) or a component of the pitch lining. Indeed, by examining the analyses of the amphorae

FIGURE 4. AFRICAN AMPHORA CONTENTS. 47: KEAY 64 (WILSON 1996; CAMPANAIO); 48: KEAY 3/5 (BONIFAY 2016; ROME); 49: KEAY 40 (BONIFAY 2016; CARTAGENA); 50: KEAY 41 (REMOLÀ 2000; TARRAGONA); 51: KEAY 62R (FREED 1995; CARTHAGE); 52: ALBENGA 11/12 (PALLARÈS 1987; ALBENGA); 53: KEAY 62A (ALBORE LIVADIE 1984; FILICUDI PORTO); 54: BONIFAY 47 (BONIFAY 2004; MARSEILLE); 55: KEAY 61C (BONIFAY 2004; ARLES); 56: KEAY 61A/D (LIOU 1975; POMÈGUES); 57: KEAY 8A (MURIALDO 1988; PIEVE DEL FINALE); 58: KEAY 34 (BONIFAY 2004; ROUGGA); 59: KEAY 50 (RADIC 1993; LASTOVO WRECK); 60: 'CON ORLO A FASCIA' (CUNJA 1996; KOPER); 61: SCHÖNE-MAU XXXV (PANELLA 1973; POMPEII); 62: PSEUDO-DRESSSEL 2/4 (BONIFAY 2004; ZARZIS); 63: DRESSSEL 30 (PANELLA 1973); 64: KEAY 1B (LONG 2002; CAMARGUE); 65: GLOBULAR TYPE 3/CASTRUM PERTI (SAGUÍ 1998; ROME). SMALL CONTAINERS: 66: BONIFAY 57 (BONIFAY 2016; LAMBAESIS); 67: BONIFAY 58 (BONIFAY 2004; NABEUL). 68: AUGST 73 (BIEN, BONIFAY AND MOLINER 2007; MARSEILLE).



● oil ● wine ● *salsamenta* ● olives ● interchangeable ● unknown



from Classe, it is troubling to note that the marker of acid ricinoleic is always associated with the marker of pitch, and in about half of the cases with markers of other contents – other vegetal oils and even fermented products (Pecci *et al.* 2010: Table 2).

Archaeometry was also used in order to better characterize the two other main products transported by amphorae beside oil, namely fish products and wine. Concerning the *salsamenta*, very innovative methods were used: paleogenetic on one side, and proteomic on the other side. The first ones allowed for the analysis of the ancient DNA present in residues conserved in the bottom of amphorae type Africana II from the Parc Saint-Georges excavations in Lyon. In one of them, probably originating from Salakta according to the petrography, the analyses revealed the presence of fish-products composed of anchovies (Silvino *et al.* 2007). The second method is still at a development stage, but results are encouraging on samples of present-day ceramics soaked in a fish mixture (Dallongeville *et al.* 2010). Lastly, the more traditional method by lipidic extraction led to the development of a protocol for the research of fish-based contents, notably in comparison with samples collected in salting vats of the fish-salting factory of Nabeul (mentioned in Garnier *et al.* 2011: 405; about the fish-salting factories of Nabeul, see Slim *et al.* 2007). Concerning wine, the DNA analyses provided evidence for such content in an African amphora of unknown typology from Lyon (Silvino *et al.* 2007: fig. 3, no.4). On the other hand, the protocols for traditional chemical analyses are now well developed, and have already provided results, mainly for Africana III (see below).

3. Updating of the content distribution by types

The quantity of available data has significantly increased over the last ten years, but their fragmentary and casual nature have not notably changed. It is certainly possible to update the hypotheses made in 2007, but we must bear in mind that they remain fragile.

3.1. Oil

We know very little about the content of the earliest Roman-African types. Traces of oil seem to have been detected in the so-called ‘Ancient African’ type (Figure 2.12) (mid 2nd century BC–early 1st century AD), but this should be checked in future (Contino and Capelli 2019: 58). According to the ovoid shape of this container, a fish-based product would also be plausible (Martin-Kilcher 2011: fig. 3), and wine cannot be excluded by comparison with some other ovoid amphorae produced in Spain (García Vargas *et al.* 2019: 410). The same issue remains pending for the successor of this type in the 1st century AD, the Dressel 26 (Contino *et al.* 2016: 155). Only one type of Punic tradition from the Hammamet gulf (type 1E) (Figure 2.6), attested at the Monte Testaccio, could have transported olive oil, but this amphora is poorly distributed.

All the arguments mentioned above demonstrate that the African amphorae of the 2nd-3rd century devoted *par excellence* to the transportation of oil are Africana I (Figure 3.22), and Tripolitana I and III (Figure 3.27-28). Among these arguments, their presence at the Monte Testaccio is not the least, and allows us to include the type Ostia XXIII (Figure 2.17), which has a slightly early onset. On the other hand, oil is probably not the usual content of type Ostia LIX or Africana II, except perhaps the so-called ‘pseudo-Tripolitanian’ variant of the latter.

The fact that it is more difficult to follow the evolution of these oil containers from the 4th century onwards has led us to consider a crisis in African olive growing during this period (Panella 1982: 178). Nevertheless, it is virtually certain that Africana I survives as a variant of Africana III (the same evolution is known for the amphorae Africana II C). It remains to be discussed which variant(s) of type Africana III was/were devoted to the transportation of oil. A good candidate could be the variant Keay 25 V (Figure 3.31), due to the similarity of rim with the latest examples of the Africana I. Tripolitana III is produced throughout the 4th century, even if less distributed than during the 3rd century (Panella 2001: 211). In the 5th century, other types seem to take over, but there is insufficient information on their content: Keay 27 (?) in the region of Carthage (Figure 3.38), Keay 35A in Nabeul (Figure 3.41), and Keay 59/8B in Southern Byzacena (Figure 3.40). The situation is even more uncertain in the Sahel region and in Tripolitania, where data on amphora production during the 5th century is almost completely lacking. In the 6th century, types Keay 62Q/Albenga 11/12 and mainly Keay 62A (Figure 4.52-53) are possible candidates for the transportation of olive oil, while the situation becomes totally unclear in the 7th century (types Keay 61 and 8A) (Figure 4.56-57).

3.2. Fish products

Republican African amphorae of Punic tradition (type Van der Werff 1-3) (Figure 2.1-3) and their ‘Romanized’ successors (type Carthage EA IV) (Figure 2.13) are traditionally considered to have transported fish products (Martin-Kilcher 1999 and 2011; Botte 2009: 115). Nevertheless, wine has been also suggested for Van der Werff 2-3 on the basis of the archaeological survey of Jerba (Fentress 2001), and recent chemical analyses (Pecci and Giorgi 2019). The most difficult problem to solve is the content of Imperial types Tripolitana II, Dressel 18 and Hammamet 1-3 (Figure 2.9, 2.5, 2.7-8): as for their predecessors, we might be tempted to expect a fish-based main content, but the location of their production, sometimes far from the coast, weakens this exclusive hypothesis: wine is also a possible solution. Lastly, on a morphological bases – in particular the long hollow spike often considered as typical of the amphorae for *salsamenta*, a fish-based content is suggested for the early Imperial types *Leptiminius* I and *Uzita* Pl. 52.10 (Figure 2.14-15).

The container which could better correspond to the abundant production of *salsamenta* in Africa (Ben Lazreg *et al.* 1995) during the mid Roman period is the Africana II. There is a high probability for the variants A and C, which are linked from a typological point of view, and provide a series of arguments, including archaeometric ones (pitch traces, macro-remains, lead labels, DNA analyses). Nevertheless, it is not certain that all variants of Africana II had the same content (Panella 1982: 176). In particular, there is a doubt for variant D (Figure 3.26), which could equally contain wine, as suggested by D. Mattingly and D. Stone (Mattingly *et al.* 2011: 217).

Africana II C (Figure 3.25) survives in the first half of the 4th century through the adoption of the slim shape of Africana III (Bonifay 2004: types Africana II C2 and II C3). On the other hand, we don't know if other medium-sized cylindrical amphorae classified under type Africana III had the same content. It could be the case of variant III B (= Keay 25.3) (Figure 3.30) of the second half of the 4th century, the rim shape of which seems to announce the development in the 5th century of the large-sized amphorae of type Keay 35B (Figure 3.42). The latter type, produced in Nabeul, with different sizes (Bonifay, Capelli and Moliner 2011: 240), brings together several arguments for a fish-based content (traces of pitch, presence on fish-salting fabrics, macro-remains in one case). Nothing secure can be said about types Keay 57-56-55 (Figure 3.44-46), which seem to supersede Keay 35 at the end of the 5th century and the 6th century, unless they have traces of pitch and we know that Keay 55, at least, didn't contain oil (Garnier in Bonifay 2007: 26-27). The latest evidence of transportation of African fish sauces is given by the *dipinti* of difficult interpretation on *spatheia* type 3 found in Egypt.

Besides these series of amphorae, even small ones, there are some very small containers devoted to the transportation of very small quantities of products (see below). Should we not consider that some of them (types Bonifay 57 and 58) (Figure 4.66-67) could have transported fish sauces (Bonifay 2004: 288)?

3.3. Wine

The reluctance expressed in the past about the production and distribution of African wine has faded over the last years. But the support of the scientific community for a wine content in several amphora types of the 4th perhaps went too far.

Surely, there is no doubt that wine was the main content of African amphorae whose form imitates the typology of wine amphorae from Italy or Gaul (Schöne-Mau XXXV, pseudo-Dressel 2/4, Dressel 30) (Figure 4.61-63), even if some cases are dubious (e.g. the content of type Keay 1B, see Reynolds 2010: note 193) (Figure 4.64). The same hypothesis for Africana III is more hazardous. Robert Lequément was the first to suggest that the medium-sized cylindrical amphorae transported wine

(Lequément 1980: 191). He was relying on the great number of exemplars presenting traces of pitch, which has been confirmed by the systematic examination of the amphorae stored in the DRASSM storerooms. In addition, the wide distribution of these amphorae better corresponded to the distribution of wine than to the distribution of oil or fish products. The fact that these amphorae appear at the end of the 3rd century or more probably at the beginning of the 4th century, at the same time as the *canon uinarius* is established, is troubling. Lastly, the help of archaeometry was decisive, with the discovery of wine traces in four exemplars of Africana III A from three different underwater sites (Woodworth *et al.* 2015: wrecks of Héliopolis 1, Pointe de la Luque B, and excavations in the river Rhone).

This hypothesis of wine for the amphorae Africana III, put forward with great caution, concurrently with the hypothesis of *salsamenta* that is more generally accepted (Reynolds 2010: note 331), was reproduced as a certainty in many publications dealing with this amphora type. Nevertheless, the arguments remain contradictory. Firstly, all variants of Africana III, which are not always recognizable with a simple rim sherd, did not transport the same content (see above for variants with a possible content of oil or *salsamenta*, even if I agree with Paul Reynolds that '[Keay 25] did not normally carry oil', see Reynolds 2010: note 331). On the other hand, the resemblance of Africana III to Africana II D is striking, and could be the key to the problem, if we knew the content of the latter type. But for this type also, we hesitate between *salsamenta* and wine. The geographical proximity between the amphora workshops and the fish-salting factories could be an argument against the wine hypothesis, but in two workshops (Oued el-Akarit and Nabeul) the production of others types corresponding to other contents (late variant of type Africana I) is also attested. Lastly, the solution can only come from archaeometry. Research protocols for identifying a wine content are beginning to show results, and it seems that traces of wine are frequently highlighted in amphorae Africana III (Alessandra Pecci, personal communication), at least for variant A (Figure 3.29).

3.4. Other contents and reuse of amphorae

Besides the three main amphora contents, oil, fish products and wine, other minority contents should be considered. For example, preserved olives are possibly mentioned in *dipinti* at Pompeii on type Ostia LIX (see above) and at Augst: *oli(vae)* on an amphora Africana III (Martin-Kilcher 1994: no.248), and attested by olive pits in amphorae Africana III C and *spatheia* type 1 (Figure 3.32-33) in the Dramont E wreck (Santamaria 1995). In the same wreck, traces of preserved meat have been also reported in fragmentary African amphorae of unknown typology (Santamaria 1995: 123).

Nevertheless, in this last example as well as in others mentioning the discovering of fig pips or date stones,

we must always bear in mind that the containers could have been reused. This could be a possible explanation for the presence of specific vegetal oils – castor oil or moringa oil – in some African amphorae (see above). This phenomenon of reusing the containers, which perhaps does not have the same frequency according to the region or chronology, is difficult to assess, but it need not stop us trying to determine the primary content of each amphora form.

3.5. Interchangeable contents

A specific problem is raised by *spatheia* type 1 (Figure 3.33). These amphorae were sometimes interpreted as small variants of *Africana III C*, with a similar content. Nevertheless, the examination of several exemplars coming from underwater or port excavations progressively convinced me that many different contents were possibly attested in these small-sized amphorae. Indeed, the exemplars from the Dramont E wreck obviously transported preserved olives; another one discovered at Tarragona contained macro-remains of fishes; lastly, some others, although complete, didn't show any traces of pitch. This inconsistency in the data led me to consider that the *spatheia* were invented in order to serve as a space filler in cargoes composed of large-sized cylindrical amphorae. Indeed, the distribution map of amphorae in the Dramont E wreck show that the *spatheia* were inserted, even in a disorderly manner (Poveda 2012), in the interstices left with the stacking of Keay 35A and B in the ship's hold (Santamaria 1995: fig. 9). According to this hypothesis, the *spatheion* type 1 would not be a specific amphora type with a specific content, but an instrument of optimisation of the cargo, created at the moment when the distribution mode of the African foodstuffs was changing, and the traders were perhaps inclined to make the cargoes as full as possible. The lifetime of this small container seems to be short, between the beginning of the 5th century and the beginning of the 6th century, but the small containers *spatheia* type 3 of the 7th century don't necessarily have filiations with those of the 5th century.

3.6. Other containers

First of all, it must be reminded that in Africa amphorae were used not only for transportation, but also for the storage of foodstuffs, in the absence of *dolia* (Brun 2003), at least in *Africa proconsularis* (not in *Mauretania caesariensis*, see Amraoui 2017: 282–285). These African storage amphorae, which cannot be classified within the classical transport amphora classifications, adopt different morphologies, some of Punic tradition, others of Greco-Roman type, and all of them reach impressive capacities (up to 140 litres). Exceptionally, these amphorae could have travelled. Some examples are known on wrecks, but in this case they don't necessarily belong to the cargo (for example at Pakostane: Huguet 2012), and even on some terrestrial sites (for example, at Rome: Contino and D'Alessandro 2014).

On the other hand, as in other regions of the Empire (especially in the *Latium*), small containers, which we cannot call amphorae, even if they have two handles (see type Bonifay 57), are suspected to have transported small quantities of products. We already mentioned the small pots that could have contained fish sauces (types Bonifay 57 and 58, see above), but a lot of other forms could have a similar purpose, notably a series of small jugs of the late Antique period (especially types Bonifay 61, 62.6, etc.). The content of these small containers is unknown, except the content of type August 73 (Figure 4.68), which could be an ointment (Marty and Capelli 2016).

Finally, the storage and transport of foodstuffs in skins and barrels in Roman Africa is now being more recognised, as attested by a good deal of representation on sculptures, mosaics and ceramics (Marlière and Torres Costa 2007). It is certain, as mentioned by the *ostraca* from Carthage (Peña 1998), that oil produced in the inland regions of Africa was transported in skins to the port warehouses, where it was poured into amphorae, and then traded overseas. It is also probable that most of the intraprovincial terrestrial trade of wine, oil and *salsamenta*, was made by means of skins and barrels. Lastly, it is not completely impossible that part of the maritime trade of Africa used barrels. This issue remains to be confirmed, in particular for the fish products (Marlière and Torres Costa 2007: 106 and note 97), and the later period (Horden and Purcell 2000: 372, 'the *post-amphora* Mediterranean'). Nevertheless direct evidence is lacking in order to support this hypothesis.

4. Conclusion

So, fifty years after the first synthesis on Roman Africa amphorae (Zevi and Tchernia 1969), we can say that their content is still poorly documented. To sum up, the presumed contents of African amphorae can be divided into three categories: 1. those which are unanimously accepted; 2. those which are matter of controversy; 3. and those which remain completely conjectural.

Within the first category, we can be sure that oil was the usual content of *Africana I*, and *Tripolitana I* and *III*; that fish products were the content of *Africana II C*; and that wine was the content of African imitations of Dressel 2/4 (= *Schöne-Mau XXXV* and local variants), Gauloise 4 (= Dressel 30) and LRA 1 (= *Henchir Chekaf IV*).

In the second category, we can classify:

- the amphorae of Punic tradition, for which we still hesitate between *salsamenta* and wine;
- the early Roman-African types (Ancient African, Dressel 26, Ostia LIX) for which different contents have been suggested (oil, preserved olives, *salsamenta*, wine);

- c. the Africana II, mainly its variant D, the content of which could be *salsamenta* or wine;
- d. Africana III, though it is not completely clear which variants were carrying wine (variant A?), *salsamenta* (variant B?), and eventually oil.

Lastly, the third category – the ‘grey area’ – gathers almost all the large-sized amphorae of the late Antique period, for which we can only put forward some very fragile hypotheses, for example: Keay 27 (oil?), Keay 35A (oil?), Keay 35B (*salsamenta*?), Keay 39 (oil?), Keay 59/8B (oil?), Keay 62 (oil?), etc. (Figure 1).

As in other regions of the Empire (e.g. in Spain), we face the same difficulties of content identification during a period of experimentation in amphora production, which seems to last perhaps longer in Africa, from the fall of Carthage to the end of the 1st century-beginning 2nd century AD. The contents are clearer from the mid 2nd century to the end of the 4th century, the more standardised African amphorae becoming at this stage ‘intelligent packaging’, as in the other regions of the Empire. Lastly, as everywhere, the most difficult problems are posed by the late Antique amphorae, from the 5th century onwards.

Fifty years ago, at the beginning of the research on African amphorae, it was unanimously stated that olive oil was the main content of these containers. Then, this hypothesis was contested, and more recently African amphorae have been less and less considered as having carried olive oil. In fact, the point is not to deny the possibility that African amphorae transported oil, but to accept the idea that the contents of these amphorae were more diverse than previously assumed. When dealing with African amphorae on consumption sites, we have to bear in mind not only that the contents are not always the same in the same period (e.g. Africana I and II), but also that the main products exported overseas may have changed over time: oil dominating between mid-2nd and mid-3rd century, then possibly *salsamenta* during the 3rd century-beginning 4th century, and perhaps wine during the 4th century.

It is distressing to see that the record on African amphora contents is perhaps one of the least advanced in the Roman Mediterranean, while these containers are among the most important in terms of production and distribution. More than ever is crucial to launch a programme of systematic chemical analyses on the contents of the African amphorae.

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