Size Matters: Estimating Trade of Wine, Oil and Fish-Sauce From Amphorae in the First Century AD[1]

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Garum – and the other types of fermented fish-sauce – was a popular part of the Roman cuisine. So important in fact that Tønnes Bekker-Nielsen argues, that although garum was not among the *big three* food items of the Roman world – wine, oil and grain – it was important enough to be a strong candidate for fourth place.[2] The arguments are based on the abundant fragments of amphorae used – mainly – to transport liquids, and found in settlements throughout the Roman world. Amphorae for garum make up a sizable part of the fragments, typically 10-20%, and in some cases even more.[3]

But while we may infer from the proportion of fragments to the proportion of *amphorae*, which suggests that somewhere between every 5 and 10 amphora on a given Roman site contained garum, there is an obvious problem if we use these numbers to describe the proportion of *volumes*. Even disregarding the complex problems of taphonomy, there is the simpler problem of size: Every time we find a typical Dressel 20 amphora, or fragments of it, we have found 60-70 litres of olive-oil, while the average Dressel 7 amphora contained no more than 14-18 litres of garum. A simple count of sherds will overestimate the volume of garum to oil, in this example by a nominal factor of four (*cf.* Fig. 1).

Size *does* matter in a realistic assessment of trade. An estimation of the volumes cannot rely on the number of sherds, but rather, the numbers must be weighted against the volume of the containers.

This is not a simple matter, given the vast typological variation of amphorae. An estimation of volumes requires knowledge not only of the mean volume of each type, but also of the specific composition of types on individual sites. This again requires extensive excavations, and also detailed publications of the pottery from the sites excavated.

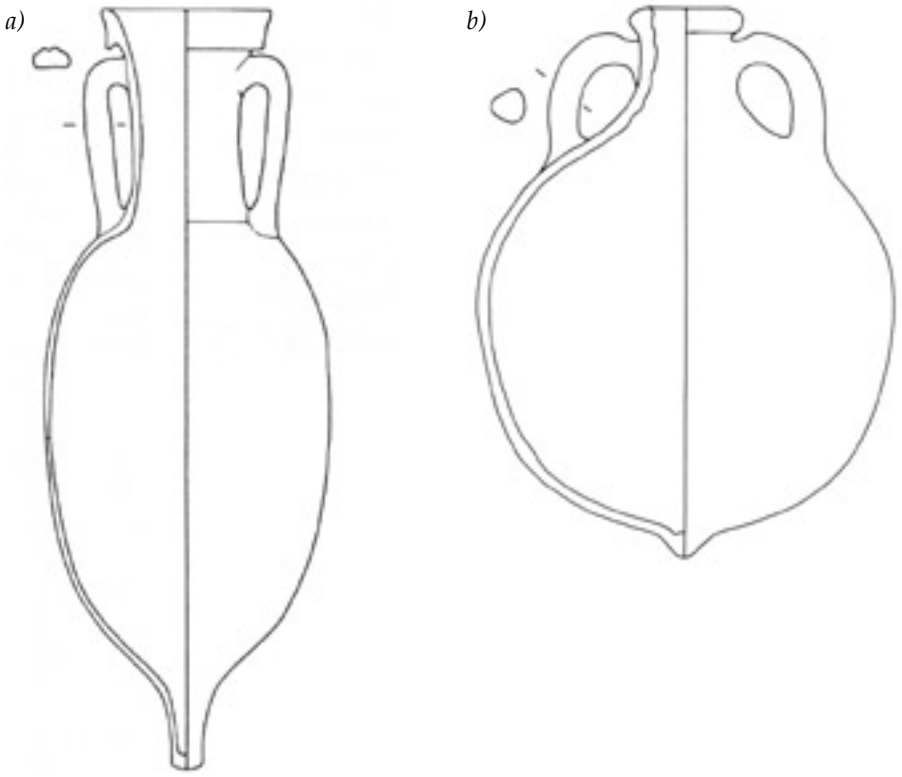

Fig. 1a-b. a) A Dressel 7 containing an average of 16 litres of garum (after Martin-Kilcher 1994a, 394). b) A Dressel 20 containing an average of 66 litres of oil (after Martin-Kilcher 1987, 55).

1. The amphorae from Augst

Well-published sites are in short supply in archaeology. But one such is the Roman colony of Augusta Raurica, today's Augst, lying at the Rhine some 10 km west of Basel in Switzerland (Fig. 2). The colony was founded in the mid-first century BC, and developed into a town of some 20,000 inhabitants during the second and early third century AD.

The extensive excavations are published in a long series of monographs – the series *Forschungen in Augst* having reached its thirty-second volume (Berger 2002) – along with numerous scientific and popular articles. The latest available bibliography (Anonymous 2001) lists more than 800 titles with Augst as the main theme.

Stephanie Martin-Kilcher published the amphorae from Augst in three extensive volumes (1987, 1994a, 1994b). The catalogue (Martin-Kilcher 1987, 1994b) lists almost 6000 numbers of typologically identifiable amphora-sherds, and apart from the typological analysis and presentation of the find, she also

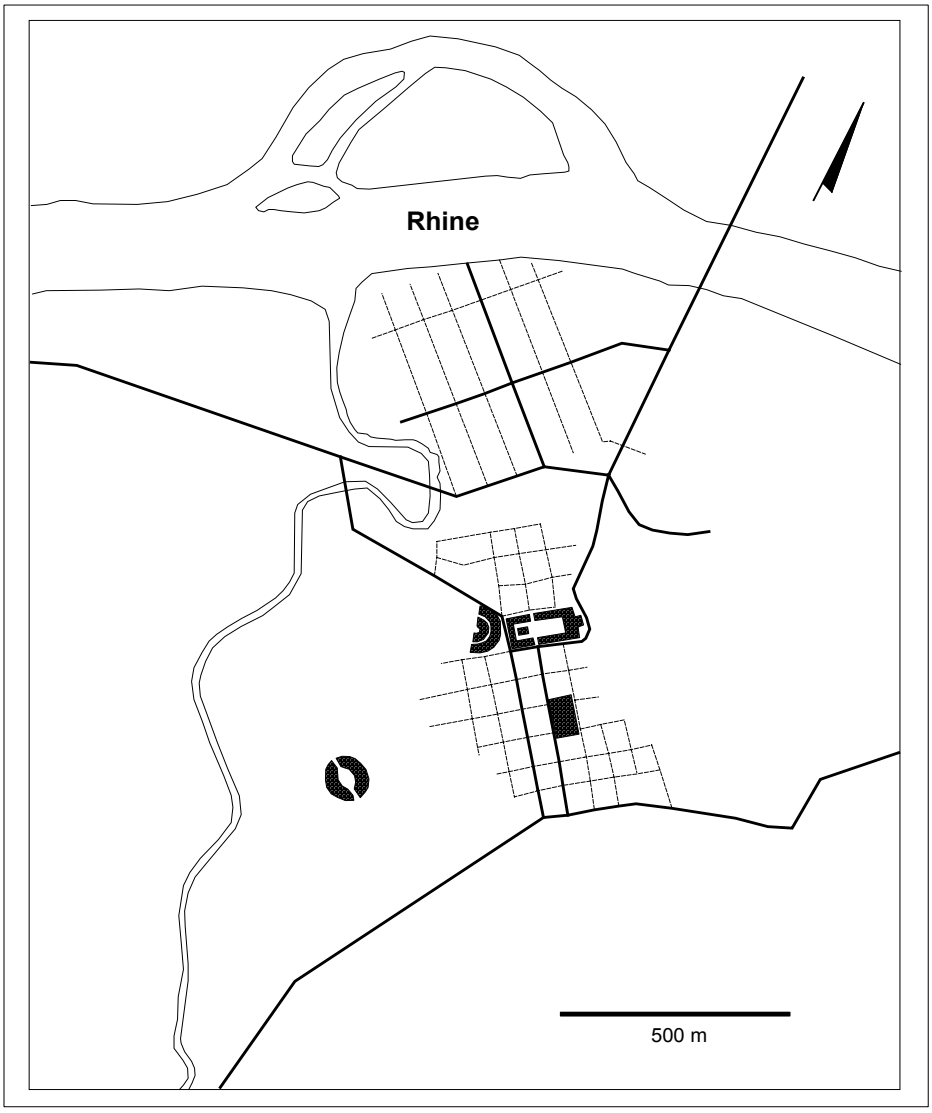

Fig. 2. The colony of Augusta Raurica. General plan with the Rhine, important buildings and roads (redrawn from Martin-Kilcher 1987, 17).

discusses central aspects of trade in Augst, which all had to rely on imports, as neither oil, wine nor garum were produced locally.

1.1 The database

For the purpose of publication a database was originally developed to register the amphorae. Unfortunately this database is not published in electronic

format, the only accessible traces of it being the lists forming the printed catalogue. Had the database been available however, for instance on a disk inlaid in one of the volumes, it is very doubtful whether it would be readable by any standard programme today. But the advantages of using electronic registration are so obvious, that the database was reconstructed for this purpose, although in a spreadsheet format, to facilitate calculations.

Over time there are considerable fluctuations in the relative number of types present at Augst.[4] To get a more stable picture the following will focus on finds from AD 30-70, which is the best represented. Not all finds can be dated precisely within this time frame, but following the method of Martin-Kilcher,[5] sherds are counted with a proportion equivalent to the number of years their context falls within the timeframe. A sherd found in layers that is dated to AD 10-50 counts with 0.5, as half the years are within the period. Assuming uniform distribution, this method should give a reasonable estimate, although the resulting sums are not integers. Sherds that cannot be dated within 100 years are disregarded.

The sherds are given both in total and minimum numbers, the latter being an empirical estimate reflecting the fact that any one pot can break into many pieces, and mainly counting the number of rims. As also shown by Martin-Kilcher,[6] there are no significant differences in the relative proportion between minimum and total number of sherds, so counting either way has no effect on the results in this case: Roughly 50% of the total sherds is part of the minimum number.

The stable relation between total and minimum numbers is reassuring in terms of taphonomy. With the total numbers we get the fragments that can be identified as belonging to any one type. With the minimum numbers, we get the number of identifiable fragments that can be separated from each other. Since the relation between what can be identified and what can be separated is much the same for all types, we get a good indication of the representtativity of the material: The larger amphorae do not seem to break into more – identifiable – pieces than the smaller ones, nor are they easier to identify. This is largely a product of the fact that the vessels are mainly identified by elements such as rims and handles, which do not vary in numbers with the size of the amphora.[7]

Establishing the new database was a simple matter of setting up various functions in the spreadsheet, and reading through the 6,000 numbers in the catalogue. More difficult was to determine the mean volume of the individual types. For the more abundant types such numbers can be found in the literature; Martin-Kilcher provides some, while another important source has been Paul Thyers very impressive web-based *Atlas of Roman Pottery*, concentrating on British sites. Most types are found in this way. For the more rare types, or those so far only known in fragments, there are no published estimates of their volumes. But for a majority of these problematic types, the Martin-Kilcher publication provides reconstructed drawings in a scale of 1:10. Using a GIS,

			All		30-70	
Type	**Content**	**μ(litre)**	**MIN**	**Total**	**MIN**	**Total**
Augst 17	Garum	20	65	98	9.4	17.8
Dressel 12	Garum	20	1	1	0.0	0.0
Dressel 7, 10, 11	Garum	16	48	55	20.2	24.9
Dressel 8	Garum	21	26	47	10.4	10.9
Dressel 9	Garum	42	27	38	7.8	9.8
Vindonissa 586	Garum	19	36	41	20.3	21.1
Pélichet 46	Garum	32	178	213	42.7	49.8
Augst 28	Garum	26	1	1	0.0	0.0
Augst 29	Garum	17.5	1	1	0.0	0.0
Augst 30	Garum	26	53	116	0.0	0.0
Group 9 ??	Garum	28.1	10	265	0.0	94.0
Dressel 10 sim.	Garum	19	49	70	20.9	27.0
Dressel 9 sim.	Garum	30	297	486	91.3	148.5
Group 10 ??	Garum	28.6	0	115	0.0	28.6
Augst 33	Garum	42	33	48	7.2	9.2
Augst 34	Garum	20	6	8	0.5	0.5
Augst 35	Garum	15	2	4	1.0	2.3
Dressel 16	Garum	10	4	6	0.4	1.2
Dressel 6A	Garum	26	1	1	0.3	0.3
Dressel 14	Garum	26	1	2	0.0	0.0
Dressel 20	Oil	66	974	2,009	265.5	474.6
Dressel 6B	Oil	20	2	3	1.3	1.7
Vindonissa 592	Oil	20	10	18	5.3	9.0
Augst 63	Oil	60	8	9	1.0	2.0
Tripolitana 1	Oil	55	2	4	2.0	3.5
Dressel 1	Wine	26	1	5	1.0	1.7
Pascual 1	Wine	25	12	21	4.1	5.4
Dressel 2-5	Wine	28	118	316	38.8	104.3
Camulodunum 184	Wine	17.5	29	121	10.2	35.6
Dressel 43	Wine	17.5	2	4	1.5	2.1
Oberaden 74	Wine	30	2	2	1.0	1.0
Gauloise 1-5	Wine	31	617	1172	88.8	169.7
Camulodunum 139	Wine	23	32	63	3.2	6.1
Augst 55	Wine	6.5	1	5	0.0	0.0
		Sum	*2,649*	*5,368*	*656.1*	*1,262.3*

Table 1. Amphorae from Augst. Types not known in first-century context are not shown.

it is possible to digitalize these drawings in true scale, and then measure the area of the cross-section of each type. By comparing these areas to amphorae of known size, it was possible to get an estimate of the volumes. The character of guesstimate must still be stressed for some of the types, but especially those very rare, and consequently with little influence on the results. The

volume of the undetermined sherds of Martin-Kilcher group 9 and 10 are set as weighted averages.

1.2 Relative imports

With these numbers established (Table 1), the amphorae from Augst provide a good example of the difference between counting sherds and measuring volumes. According to the simple count of the pottery, the imports of wine, oil and garum are roughly comparable in size, with 1/3 each (Fig. 3, left). But weighting the occurrence of individual types with their volume gives a very different picture (Fig. 3, right). Wine is reduced to a mere 15% of the total volume while oil is the dominant product, with almost 2/3 of the total. Figure 3 should prove the point of this paper's title.

1.3 Absolute imports

The relative abundance of sherds is relatively unproblematic to establish. There are some obvious problems of statistical and taphonomic character, and probably some less obvious ones too, but with excavations at this scale the result can be considered statistically relatively stable.

Estimating the absolute volumes is much more problematic. Acknowledging this, but also pointing to the fact that the number of fragments actually found equivalate an annual import of only 2½ amphorae of oil, or 165 litres, Martin-Kilcher gives an estimate of the imports of oil.[8] Several historical and archaeological sources are used to estimate an annual consumption of nine Roman pounds of oil per capita. Based on an average population of 12,000 people, and assuming that only half the population were actual consumers, the result is an import of 270 amphorae per year, or 17,820 litres. The estimate seems to be on the conservative side, but gives us an idea of the actual volumes

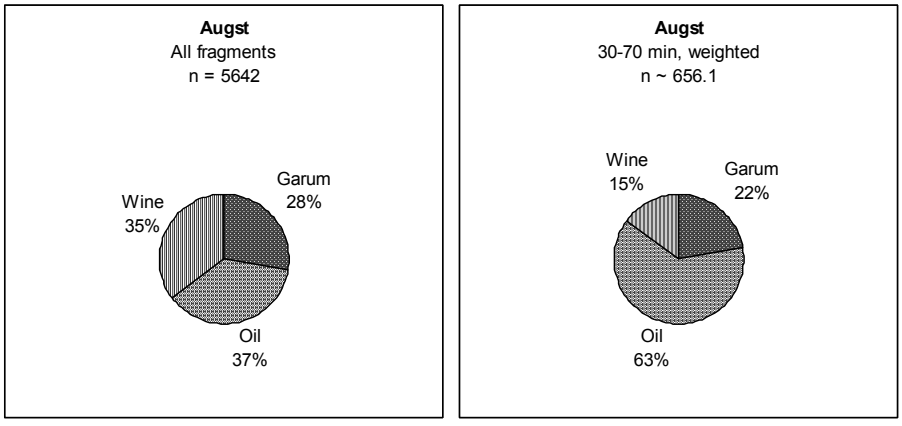

Fig. 3. Wine, oil and garum at Augst. Left: The proportion between all fragments (Martin-Kilcher, Abb. 204). Right: The proportion between volumes at AD 30-70.

consumed. Using this estimate as a basis, the annual import can be calculated as roughly 4,000 litres of wine and 6,000 litres of garum (Table 2).

It is difficult to relate such numbers to anything real. But using the same basis as Martin-Kilcher; a population of 12,000 of which only half are actual consumers, these numbers would be equivalent to a consumption of 0.7 litres – or one bottle – of wine per person per year. Where in relative numbers the low representation of wine in Augst was remarkable, these numbers tell us that there must be something wrong, and that even the meticulous counting and weighting of each individual container gives us a false picture of the actual imports. Size is not enough to get a reasonable estimate.

2. *Trade in oil, wine and garum*

One way to explain this problem is to look at the distribution at other contemporary Roman sites. In fact a detailed investigation would require all such sites to be as well published as Augst, and the establishment of new detailed databases of every fragment of pottery. But if we keep the investigation within Western Europe, and within the first century AD, it should be possible to apply the Law of Averages, using the average volume of amphorae from Augst to estimate the volumes at other sites. These average volumes are given in table 3.

	Volume (litres)
Wine	4,285
Oil	17,820
Garum	6,271

Table 2. Estimated annual imports of wine, oil and garum in Augst.

	Volume (litres)
Wine	29.0
Oil	65.5
Garum	27.9

Table 3. Mean volumes of amphorae at Augst.

Martin-Kilcher (1994a) provides numbers for the relative occurrence of sherds at other sites as well. Limiting the investigation to the first century AD and omitting the villas, which are not comparable to the towns, we have the relative composition of sherds from wine, oil and garum from another four sites: Nijmegen, Avenches, Saint-Romain-en-Gal and Rome. These are not many to compare with, but they provide a cross-section of Europe from Nijmegen in the North to Rome in the South. Weighting the relative numbers of fragments from each site by the average volumes from Augst, these few sites actually outline a distinct geographical pattern (Fig. 4).

The strong dominance of oil is not particular to Augst but can also be seen at Nijmegen and Avenches, all three situated in the northern part of the Empire, while the two southern, but otherwise very different, sites of Saint-

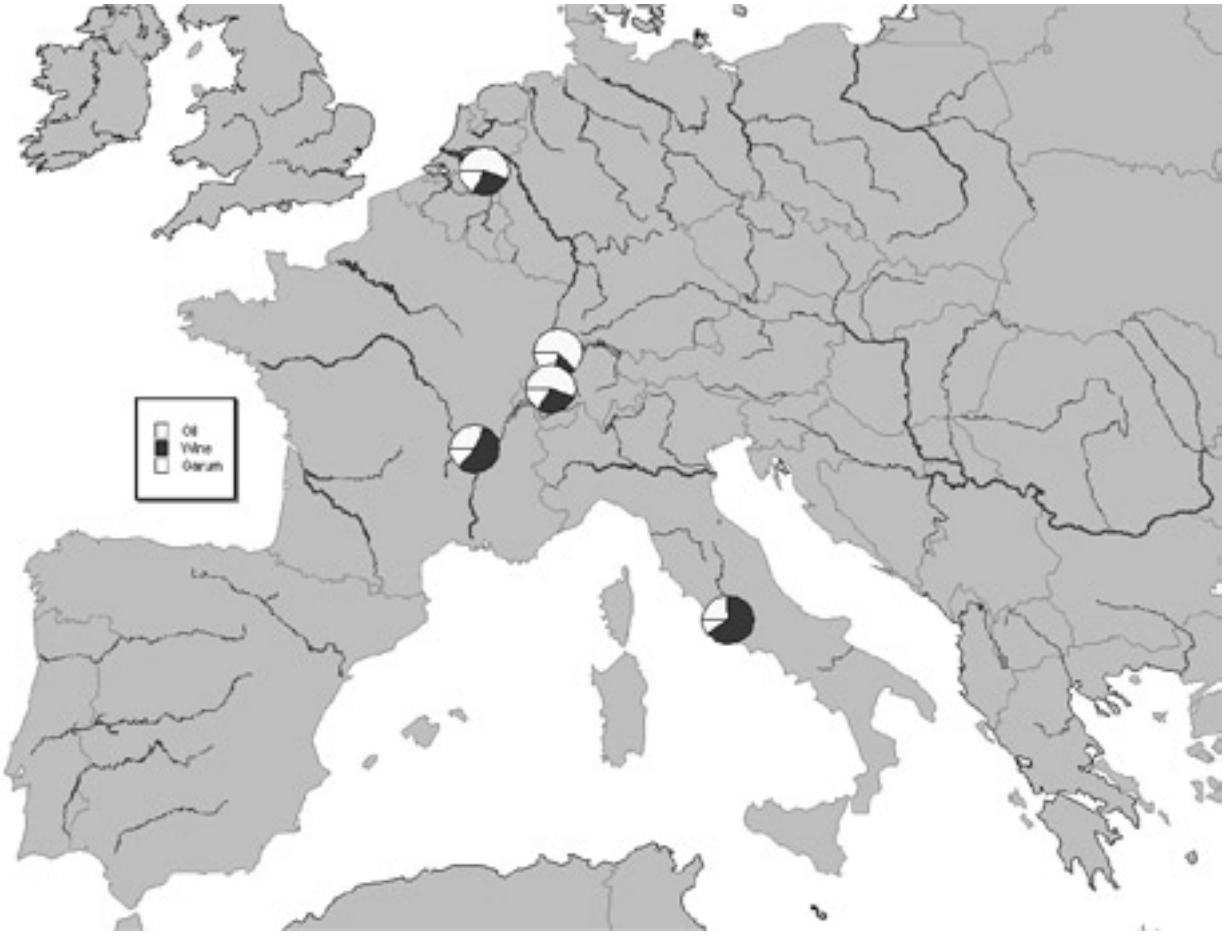

Fig. 4. Relative volumes of oil, wine and garum in Western Europe. Modern borders from World Data bank 2 (CIA 1972).

Romain-en-Gal and Rome are both dominated by wine. Apparently there are two separate groups in this material, with oil-dominance in the north, and wine-dominance in the south.

One explanation could be that wine in the northern part of the Empire was primarily transported in barrels, and is not represented with the amphorae. This explains the dominance of oil in the North. Since barrels are difficult to document archaeologically, wine becomes invisible to us. This explanation can be corroborated by the fact that the relation between oil and garum is very stable between all of the sites, with 25-30% of the volumes being garum (Fig. 5). Although figure 4 seems to indicate two very different patterns of consumption, figure 5 points to the fact that wine is the variable factor.

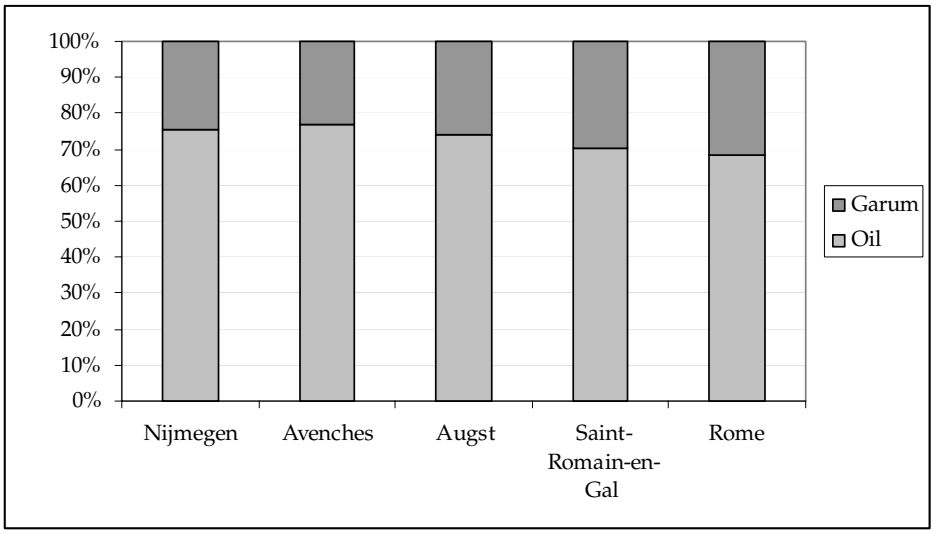

Fig. 5. The relation between oil and garum on the five sites.

During the first century AD both oil and garum were produced around the Mediterranean, strongly dominated by Andalusia in Southern Spain. These products came in amphorae, and they are therefore relatively easy to find, which explains the stable relation found on Fig. 5. Opposite this, there was a local production of wine in Gaul, which was mainly distributed in barrels, making wine more difficult to find.

Assuming that the patterns of consumption were much the same across Europe, one can speculate as to how much wine is missing in Augst. The average volumes on the two Mediterranean sites in this investigation are 62% wine, 28% oil and 10% garum. These averages can be replicated in Augst, if we assume that *c.* 90% of all wine came to this site in barrels, thus being invisible in the archaeological record. Using the absolute numbers calculated by Martin-Kilcher, where 17,820 litres of oil were consumed every year, this

	Mediterranean	**Augst**	
	Relative volumes, %	Absolute, litres	Relative volumes %
Wine	62.25	39,725	62.25
Oil	27.92	17,820	27.92
Garum	9.83	6,271	9.83

Table 4. The average imports to Saint-Romain-en-Gal and Rome can be replicated exactly in Augst by simply changing the volumes of wine. Cf. table 2.

would equal an "invisible" annual import of *c*. 35,500 litres of wine in barrels (Table 4).

The absolute volumes only serve as illustration. What is important is to point to the high degree of stability in the relation between oil and garum. They are specialized products, produced in distinct regions and distributed in containers, which make them easy to trace. Apparently they were also imported in equal proportions across the Empire – or at least the western part of it, which is examined here.

3. *Domestic imperialism – towards a conclusion*

The Roman way of life left us with some very spectacular features. The villas, aqueducts, baths and arenas are well known elements across the Empire, reflecting that Roman soldiers and administrators brought their culture with them, but also that the local populations were "Romanised", sometimes remarkably fast. These spectacular buildings are an important and highly treasured part of the local cultural heritage wherever the Romans went.

What this study seems to suggest is that "Romanisation" is not just about the spectacular. It is also reflected in the very near and personal question of what to eat. This is not a matter of whether the Roman and Romanised people utilised local food resources. They did, but what is suggested by figure 5 is that there was very little regional variation in how much oil you would cook your food in, or how much garum you would pour over it to get that genuine Roman flavour. Romanisation happened not only in the public sphere of gladiatorial games and water supply. It was also a domestic matter with a tangible impact on the dinner table. Speaking of a "domestic imperialism" is not misleading altogether.

If this interpretation is true, it also has implications on the discussions of substitution, i.e. whether oil can be replaced by animal fat, wine by beer – or garum perhaps with salt.[9] Before going into this discussion it is important to recognize that in working with imported goods such as wine, oil and garum, our data mainly reflect the situation of the upper social strata. Martin-Kilcher assumes that only half the population in Augst had access to the imported olive-oil.[10] The remainder of the population, whatever fraction it may have been, must have used another type of fat in their food, and had no choice but to find a substitute for oil.

But for those who had the means there are no real suggestions of such a substitution. The relative consumption of both oil and garum is the same from the Netherlands to Italy, demonstrating that those who could buy these foods also did. Wine and its possible substitution with beer are more difficult to assess as neither can be documented archaeologically. But following the line of reasoning above, that Spanish oil and garum was brought all across Europe because it was a proper part of Roman lifestyle, one could speculate that beer – with which Tacitus, at least, did not feel at ease (*Germania* 23.1)

– is an unlikely candidate to fill the barrels that are so obviously missing in both Augst, Avenches and Nijmegen.

Finally it is also important to remember that what is discussed here is based solely on sources from Western Europe. With the Black Sea Centre we have a unique opportunity for comparison with conditions at the other end of the Roman Empire. Just like those in Western Europe, the Romanised people at the Black Sea had villas, arenas and aqueducts. These features are known, and have been so for a long time. Maybe an interesting next step in the investigation of Roman impact and integration of the Black Sea would be to ask just how much garum they consumed.

Notes

1 I would like to thank the organizers for the invitation to speak at the workshop in Esbjerg. Dr. Tønnes Bekker-Nielsen is thanked both for the encouragement to make this study on the other side of the borderline between prehistoric and classical archaeology and for bibliographical help.
2 Bekker-Nielsen 2002a, 35.
3 Bekker-Nielsen 2002a, 34f.
4 Martin-Kilcher 1994a, 466ff.
5 Martin-Kilcher 1994a, 466.
6 Martin-Kilcher 1994a, 555.
7 Bekker-Nielsen 2002a.
8 Martin-Kilcher 1987, 193ff.
9 Cf. Bekker-Nielsen 2002a.
10 Martin-Kilcher 1987, 193ff.