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New evidence from a Roman context in Belgium for fish sauce locally produced in northern Gaul

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ABSTRACT: Fish remains from a mid-2nd century AD context at Tienen (Belgium) are believed to represent the remains of a fish sauce produced in northern Gaul. The observed species spectrum, the reconstructed sizes of the fish, and modern data on the abundance, geographical distribution and size of fish in the surf zone of the Belgian coast and in the estuary of the Scheldt basin, together indicate that the species present in the sauce were captured in the upper reaches of an estuary. Using similar reference data it was also possible to establish that the fish were caught during spring or early summer. After a discussion of the possible fish catching methods used in estuaries during Roman times, the assemblage from Tienen is compared to other Roman finds of locally produced fish sauce that have been reported thus far from sites in Great Britain and Belgium.

KEYWORDS: ROMAN PERIOD, BELGIUM, FISH SAUCE, CLUPEIDS

RESUMEN: Un conjunto de restos de peces procedente de un contexto del segundo siglo de nuestra era en Tienen (Bélgica) se interpreta como restos de una salsa de pescado producida en el norte de la Galia. El espectro de especies detectadas, las tallas inferidas de estos peces y los datos modernos sobre la abundancia, distribución geográfica y tamaño de los peces en la zona de mareas de la costa belga y en el estuario de la cuenca del Scheldt, indican que las especies presentes en esta salsa fueron capturadas en los márgenes superiores de un estuario. Utilizando información comparativa similar ha sido también posible establecer que los peces fueron capturados durante la primavera o principios del verano. Trás una valoración acerca de las posibles técnicas de captura de peces utlizadas en los estuarios durante época romana la muestra de Tienen se compara con otros hallazgos de época romana que se corresponden con producciones locales de salsas de pescado registradas hasta la fecha en yacimientos de la Gran Bretaña y Bélgica.

PALABRAS CLAVE: PERIODO ROMANO, BÉLGICA, SALSA DE PESCADO, CLUPEIDOS

INTRODUCTION

During 1995 and 1996, a rescue excavation had to be undertaken by the Institute for the Archaeological Heritage of the Flemish Community (now Flemish Heritage Institute) at the 'Zijdelingsestraat' site at Tienen, Belgium (Figure 1). The archaeological fieldwork unearthed the remains of part of a Roman small town (*vicus*), once situated along the road from Roman Tongeren (Belgium) to Cassel (northern France), another Roman *civitas* capital. Excavation revealed the remains of a section of a street, a *horreum* (grain storage building), a public bathhouse and a series of houses, amongst others. They all date from the 1st to the middle of the 2nd century AD. The excavation results are not yet fully published but two preliminary reports exist (Vanderhoeven *et al.*, 2001, 2002).

Along the Roman street, refuse deposits were found, dating from around the middle of the 2nd century AD. Amongst the refuse, a concentration of small bones was noticed and sampled as a whole. The sieving of two sample volumes, one of 12 litres and one of 10 litres, proved the concentration of minute bones to mainly represent the remains of small fish. A connection with habitation

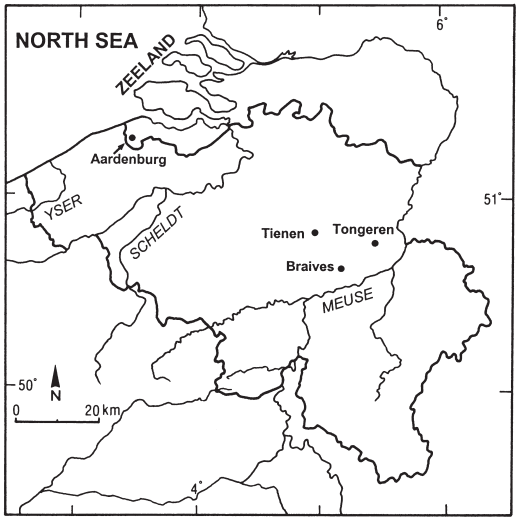

FIGURE 1

Recent topography of the discussed area, with the localities mentioned in the text.

traces on the site could not be made, but the taphonomical characteristics indicate that the fish assemblage represents a single event deposition. In the present report, the analysis of this assemblage will be presented within the context of the (still largely unknown) exploitation of marine resources in northwestern Europe, during Roman times.

MATERIAL AND METHODS

The two soil samples (one of 12 litres and another one of 10 litres) were wet-sieved on a series of 4, 2, 1 and 0.5 mm meshes. Of the 10 litre sample only the 4 and 2 mm fractions were analysed, but in the case of the 12 litre sample the smaller fractions have also been studied. In addition to the complete 4 and 2 mm fractions from the 12 litre assemblage, subsamples were taken from the 1 and 0.5 mm residues. In the case of the 1 mm fraction, 12.7% of the total weight of the residue was studied; from the 0.5 mm material a subsample was analysed that corresponded to 4.6% of the total residue weight.

Identifications were carried out by comparison with the modern reference collections of the Royal Museum for Central Africa (Tervuren, Belgium). The reconstruction of the body length of the fishes was usually obtained by direct comparison with specimens of known size. To reconstruct herring (*Clupea harengus*) and sprat (*Sprattus sprattus*) length, however, a regression was performed between the greatest width of the basioccipital as an independent variable and standard length as the dependent variable. This was done for herring and sprat separately, and, following Desse & Desse-Berset (1996), also for the two species together. The metrical relationship was calculated using the least squares method (Leach *et al*., 1996; Grouard, 2001). Because of the small size of the clupeid basioccipitals, measurements were taken to the nearest 0.01mm, using a binocular microscope with a grid (Graticules Ltd, Tonbridge, UK). The measuring error appeared to be about 0.02 – 0.03 mm, at the most.

Data on the distribution and seasonal abundance of fish along the Belgian coast and in the Scheldt estuary have been compiled from Poll (1947), Nijssen & de Groot (1987), Maes *et al*. (1997, 1998a, 1998b), Maes (2000), Maes & Ollevier (2002) and Beyst *et al*. (2001, 2002). This information was used to reconstruct the spatial and seasonal origin of the Tienen fish sample.

RESULTS

Table 1 gives an overview of the exact find numbers of the analysed material. In Table 2 the absolute numbers of the investigated subsamples from the 1 and 0.5 mm sieved residue fractions of the 12 litre assemblage have been extrapolated, in order to reconstruct the finds numbers as if the whole sample volume had been investigated. Amongst the 5,907 analysed fish bones, the remains of only one freshwater species were found. All other species were either diadromous fishes, or marine species which show a coastal and estuarine distribution (Figure 2). The assemblage was dominated by remains of small clupeids (sprat and herring) that represented 93% of the total number of finds. Flatfish (Pleuronectidae sp.: 4%) and whiting (*Merlangius merlangus*: 1.6%) were fairly common while other taxa were poorly represented. In addition to the fish bones, a small amount of crustacean remains was found.

Clupeiformes

The majority of the bones from the sample consisted of the remains of small clupeids that could be attributed to either herring (*Clupea harengus*) or sprat (*Sprattus sprattus*). One pre-

VOLUME	12 LITRE	12 LITRE	12 LITRE	10 LITRE
MESH SIZE	4+2 mm	1 mm	0,5 mm	4+2 mm
PERCENTAGE ANALYSED	100%	12,7%	4,6%	100%
Anguila anguilla	1	--	--	--
Cyprinidae indet.	--	--	--	1
Alosa sp.	--	--	--	4
Sprattus/Clupea	72	1448	835	25
Osmerus eperlamus	2	--	--	1
Merlangius merlangus	5	46	6	--
Gasterosteus aculeatus	--	6	--	--
Agonus cataphractus	--	--	1	--
Echiichthys vipera	12	10	--	2
Ammodytes tobianus	1	24	2	--
Gobiidae indet.	--	--	3	--
Platichthys flesus	3	2	2	1
Pleuronected platessa	2	--	--	5
Pleuronectidae indet.	128	123	5	100
Solea sp.	1	--	--	--
unidentified fish	60	125	2830	13
total fish	287	1784	3684	152
Decapoda Natantia indet.	--	32	+	--

TABLE 1

Overview of the analysed material from the 12 and 10 litre samples with indication of the percentage analysed for each sieve fraction. Figures indicate number of identified specimens (NISP); + = present.

caudal and two caudal vertebrae of a 15 cm SL shad (*Alosa* sp.) were found in the largest fraction of the 10 litre sample. In addition a poorly preserved opercular of shad was found. None of the remains could be assigned with certainty to either allis shad (*Alosa alosa*) or twaite shad (*Alosa fallax*). Apart from shad, other clupeids, such as sardine (*Sardina pilchardus*) or anchovy (*Engraulis encrasicolus*), were not represented in the assemblage. About 57% of the herring/sprat bones were vertebrae, the remaining being head elements, amongst which the prootic was the most common (Table 3). In the 12 litre sample 497 prootics were found, but after correcting for the fact that only a portion of the smaller residue fractions had been studied, it was estimated that a total of around 4,016 prootic elements must have been present. This suggests that the 12 litre sample contained the remains of about 2,000 herring (MNI).

The basioccipital was the most common element that was sufficiently preserved for biometrical analysis (24 specimens in the 0.5 mm fraction and 23 specimens in the 1 mm fraction). Of 24 modern herring and 19 sprat, both with standard lengths varying between 5.3 and 12.0 cm, the greatest width of the basioccipital was measured and regressed against the standard length (SL) and the total length (TL). As mentioned earlier, this analysis was done for herring and sprat separately, and also for the two species together (Table 4 and Figure 3). Since bones of herring and sprat are difficult to distinguish, we used the latter equation for size reconstruction. Moreover, it appears from the calculated curves that the differences are minimal. Using basioccipitals derived from the 1 mm and 0.5 mm sieve fraction and after correction for partially taken samples, we reconstructed the size distribution of herring and sprat (Figure 4). The range was estimated at between 3 and 14 cm TL with a modal length of 5 to 5.5 cm.

VOLUME	12 LITRE	12 LITRE	12 LITRE	12 LITRE	12 LITRE
MESH SIZE	4+2 mm	1 mm	0,5 mm	all	all
PERCENTAGE	100%	extrapolated to 100%	extrapolated to 100%	extrapolated to 100% (absolute numbers)	extrapolated to 100% (proportions)
Anguila anguilla	1	--	--	1	0,0
Sprattus/Clupea	72	11410	18153	29635	93,0
Osmerus eperlamus	2	--	--	2	0,0
Merlangius merlangus	5	362	130	498	1,6
Gasterosteus aculeatus	--	47	--	47	0,1
Agonus cataphractus	--	--	22	22	0,1
Echiichthys vipera	12	79	--	91	0,3
Ammodytes tobianus	1	189	43	234	0,7
Gobiidae indet.	--	--	65	65	0,2
Pleuronectidae all	133	985	152	1270	4,0
Solea sp.	1	--	--	1	0,0

TABLE 2

Species composition of the 12 litre sample after correction for the partially investigated samples from the 1 and 0.5 mm fractions. All the figures indicate absolute NISP, except the last column in which the proportions between the various taxa have been calculated as percentages of the NISP.

Pleuronectidae and Gadidae

Fifteen out of 371 flatfish bones could be identified to species level, with seven bones belonging to plaice (*Pleuronectes platessa*) and eight to flounder (*Platichthys flesus*). The skeletal elements allowing species identifications were skull fragments, pharyngobranchial plates, a premaxilla, a dentary, and dermal denticles. The majority of the flatfish bones were from individuals measuring between 8 and 12 cm SL with, occasionally, observations of smaller (between 6 and 8 cm SL) and larger fishes (maximally about 15 cm SL).

Of the 57 remains identified as whiting (*Merlangius merlangus*), 50 were precaudal and caudal vertebrae. Cranial elements included a posttemporal, an articular, a maxilla, two premaxillae, and a dentary or premaxilla fragment. A gadid pterygiophore of small size was also attributed to whiting. All remains were from small fish, mainly measuring between 5 and 10 cm SL. Two specimens were larger (10-12 cm SL).

Other fish taxa

Six remains of stickleback were found: a skull fragment, two basipterygia, two pterygiophores and a ventral spine. Using the diagnostic criteria described by Libois *et al*. (1987), the spine and basipterygia were identified as three-spined stickleback (*Gasterosteus aculeatus*). The presence of hooknose (*Agonus cataphractus*) was indicated by a scute found in the smallest sieve fraction; this element did not allow precise size reconstruction. Twenty-four bones of lesser weever (*Echiichthys vipera*) included a maxilla, a palatine, two dentaries, three articulars, four operculars, six precaudal and seven caudal vertebrae of specimens measuring between 5 and 10 cm SL. Twenty-four of the 27 remains of sandeel (*Ammodytes tobianus*) were precaudal vertebrae. Two operculars and an articular were the only cranial elements of this species that were recovered. In the 1 mm fraction, which contained the majority of sandeel remains, most of the specimens (22 out of 24) had a reconstructed body size of 8-10 cm SL. The other two specimens were slightly larger (10-12 cm). The two vertebrae found in the 0.5 mm fraction were much smaller than a reference specimen of 9 cm SL. The smallest fraction also yielded the only three remains of Gobiidae. The goby bones were two premaxillae and a maxilla of fish measuring less than 5 cm SL. The finds belong to the Gobiidae family but, as the species within that family exhibit a very similar morphology, a more detailed identification was not attempted. Smelt

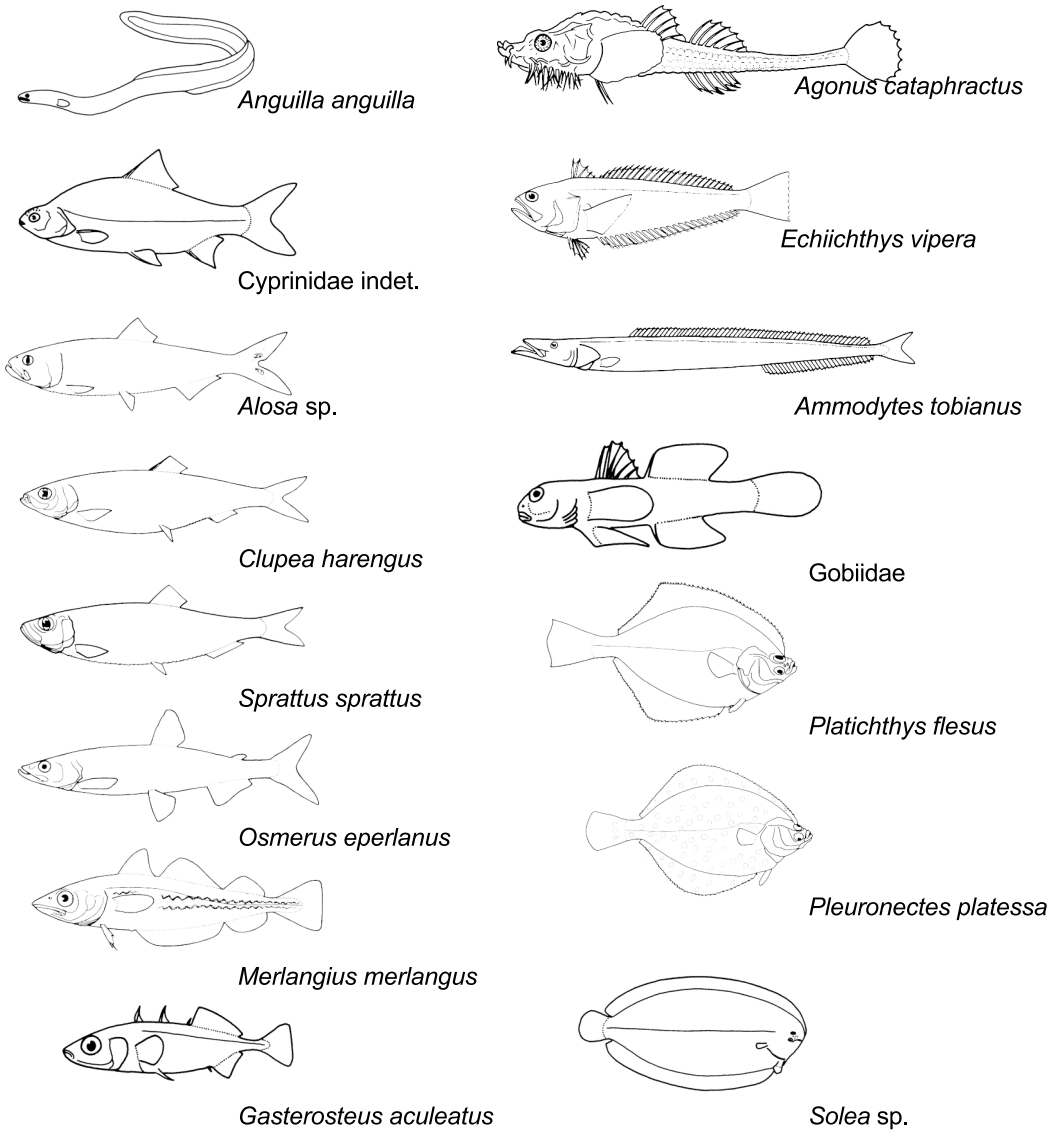

FIGURE 2

Fish species identified from the fish sauce at Tienen.

(*Osmerus eperlanus*) was represented by a dentary and a ceratohyal found in the largest sieve fraction. The reconstructed body size ranged between 10 and 12 cm SL. The presence of a small specimen of sole (*Solea* sp.) measuring 7-8 cm SL was indicated by a caudal vertebra. Eel (*Anguilla anguilla*) was represented only by a precaudal vertebra of an animal measuring between 30 and 40 cm SL. One cyprinid bone was found: a caudal vertebra of a 10-15 cm long individual. The species could not be identified due to the absence of diagnostic characters on the find.

VOLUME	12 LITRE	12 LITRE	12 LITRE	10 LITRE	TOTAL
MESH SIZE	4+2 mm	1 mm	0,5 mm	4+2 mm	
PERCENTAGE ANALYSED	100%	12,7%	4,6%	100%	
Prootic	46	421	30	14	511
Basioccipital	--	25	28	--	53
Other neurocranium fragments	1	149	3	2	155
Articular	--	22	31	1	54
Dentary	1	68	54	2	125
Maxilla	1	12	44	--	57
Quadrate	2	6	9	1	18
Ceratohyal	--	7	4	1	12
Epihyal	--	2	--	--	2
Urohyal	--	1	--	--	1
Hyomandibular	--	6	6	--	12
Opercular	--	7	6	--	13
Branchial element	--	1	--	--	1
Posttemporal	--	1	1	--	2
Supracleithrum	1	1	--	--	2
Cleithrum	--	--	10	1	11
Postcleithrum	2	2	--	--	4
Precaudal vertebrae	9	--	--	--	9
Caudal vertebrae	7	--	--	2	9
Urophore	--	1	--	--	1
Precaudal or caudal verebra	1	707	609	--	1321
Scale	1	1	--	1	3
Unidentified flat bone	--	8	--	--	8
Total	72	1448	835	25	2380

TABLE 3

Skeletal distribution of the analysed sprat/herring material from the 12 and 10 litre samples with indication of the percentage analysed for each sieve fraction. Figures indicate number of identified specimens (NISP).

SL sprat = $5{,}499x^{1.2188}$	$R^2 = 0.8582$; n = 19
SL herring = $5.61x^{0.9942}$	$R^2 = 0.8781$; n = 24
SL herring/ sprat = $5.508x^{1.0921}$	$R^2 = 0.8587$; n = 43
TL sprat= $6.6259x^{1.1604}$	$R^2 = 0.8760$; n = 19
TL herring = $6.6316x^{0.9868}$	$R^2 = 0.8773$; n = 24
TL herring/sprat = $6.639x^{1.0671}$	$R^2 = 0.8684$; n = 43

TABLE 4

Power equations for the calculation of standard length and total length in sprat, herring, and herring/sprat starting from the greatest width of the basioccipital (x). R^2 = coefficient of determination, n = number of measurements.

Crustacean remains

Besides fish bones, remains of small natant decapods were also found in the 1 mm and 0.5 mm fraction. They consist of minute fragments of the exoskeleton that do not exhibit any diagnostic characters. It is likely, however, that they represent either common shrimp (*Crangon crangon*) or prawns (Palaemonidae sp.). Fragments of these two taxa have previously been reported from the 17th century fill of a cesspit from a house in Antwerp (Belgium). These were believed to have been derived from the Scheldt estuary (Veeckman *et al*., 2000).

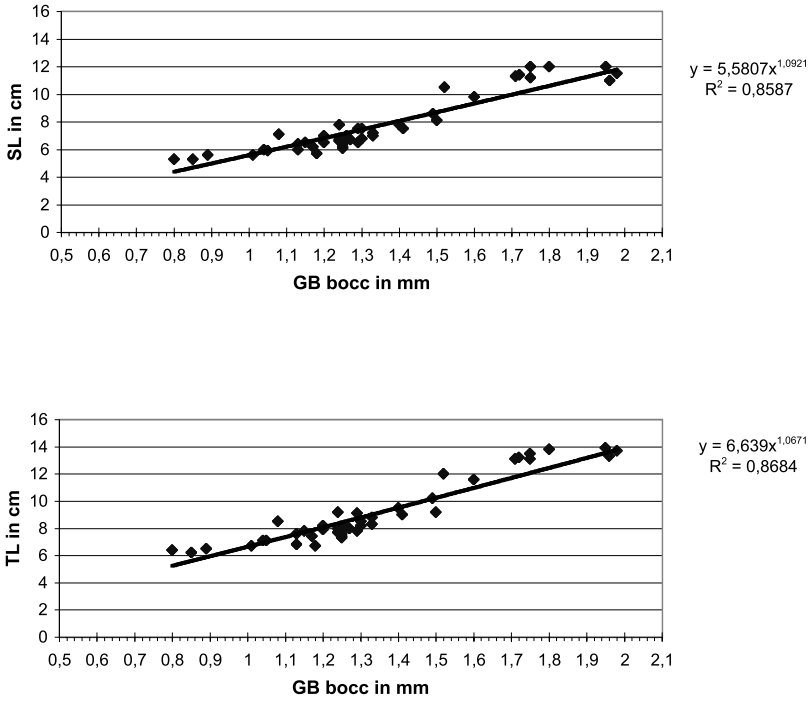

FIGURE 3

The correlation between the greatest width of the basioccipital and body size in herring/sprat. Upper panel: standard length; lower panel: total length.

DISCUSSION

Spatio-temporal reconstruction of the origin of the Tienen fish sample

All of the species found in the context from Tienen are distributed along the North Sea coast, or in fresh water, and are known to penetrate estuaries. In estuarine environments the relative species composition varies, both on a seasonal and a spatial scale. The composition of the Tienen assemblage, combined with the data on reconstructed fish length, can therefore be used to determine where the fish were captured and during which season of the year this happened.

The archaeological sample comprised, in general, juveniles of marine fish species. At present, young marine fishes live in inshore areas along the North Sea coastal zone. Based on an analysis of fish captures along the coasts of Great Britain, Henderson (1989) identified four different fish assemblages, each associated with different environments: sheltered estuarine habitats, sheltered marine habitats, exposed estuarine habitats and

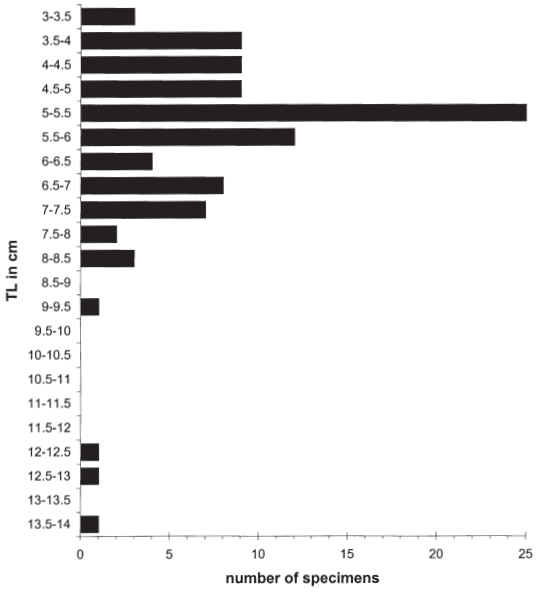

FIGURE 4

Distribution of the reconstructed total lengths for the herring/sprat from Tienen.

SITE	TIENEN	TIENEN/MITHRAS	BRAIVES	BISHOPHILL	PENINSULAR HOUSE
DATE	mid-2nd c. AD	second half of the 3rd c. AD	3rd c. AD	late Roman-early postroman	mid-3rd c. AD
REFERENCE	this study	Lentacker *et. al.,* 2004	Van Neer & Lentacker, 1994	Jones, 1988	Batteman & Locker, 1982
VOLUME	12 litre	10 litre	20 litre	0.1 litre	35 grams of residue
MESH SIZE	0,5	0,5	0,5	?	0,25
Anguilla anguilla	1/1	--	--	--	--
Clupea & Sprattus	29635/2008	35/2	77/3	5756/45	?/126
Osmerus eperlanus	2/1	--	1/1	--	--
Merlangius merlangus	498/16	--	3/1	1/1	--
Gasterosteus aculeatus	47/16	--	1/1	--	--
Agonus cataphractus	22/22	--	--	--	--
Dicentrarchus labrax	--	--	--	--	?/1
Echiichthys vipera	91/17	--	--	--	--
Ammodytes tobianus	234/38	--	1/1	--	--
Hyperoplus lanceolatus	--	--	--	--	?/1
Gobiidae indet.	65/22	--	--	--	--
Pleuronectidae all	1270/50	--	--	--	2/1
Solea sp.	1/1	--	--	--	--

TABLE 5

Composition of the local fish sauces described thus far from northwestern Europe. Figures indicate NISP and MNI. For the present sample from Tienen the extrapolated figures are given for the 12 litre sample; the figures for Braives have been adapted from those given in the original publication because the bones initially described as an unidentified species appear to belong to juvenile clupeids.

exposed marine habitats. The archaeofauna described here corresponds to the typical fauna of soft bottomed, sheltered zones of North Sea estuaries. Dominant members of this assemblage are gobies, herring, whiting, flounder and three-spined stickleback (Henderson, 1989; Thiel *et al*., 1995; Maes *et al*., 1998a); all species that were present and in some instances very common in the Tienen sample. These species may also be found on sandy beaches of the North Sea coast (Beyst *et al*., 2001) but the probability for capture is much higher in an estuarine environment: the species reach higher densities (as numbers per volume water) in an estuary as compared to the coastal zone (Maes *et al*., 1998a). This is especially evident for three-spined stickleback, smelt and eel. If the archaeological sample had been derived from a sandy coastal area, a higher proportion of flatfish would also have been expected. Further evidence in support of the hypothesis that the fish sauce was derived from an estuarine catch is provided by the presence of a cyprinid bone in the sample. It is known that cyprinids do not tolerate salinities above 15 ‰ (Thiel *et al*., 1995). Other fish species found in this study, such as the hooknose and the lesser weever, show a more coastal distribution but none of these species avoids brackish water areas and they may well penetrate into the oligohaline zones.

The season in which the original sample was obtained can be inferred from recent data on the temporal distribution of fishes in estuaries. All species recorded at Tienen are, in general, either off-shore, winter or spring-spawned fishes, using the estuary as a nursery, or migrant fish species with a catadromous or anadromous life history. The times of their arrival in and departure from North Sea estuaries differ, which results in predictable seasonal changes in the species composition of the fish assemblage. Mixed schools of young herring and sprat –often also together with immature shad– enter estuaries during spring months as early juveniles (modal total length 4-5 cm) and during winter as age I juveniles (modal length 8-10 cm). In periods of estuarine migration, herring

and sprat strongly dominate the fish fauna in terms of numbers (Maes *et al*., 1998a; Power *et al*., 2000). The size distribution of the herring and sprat (Figure 4) shows that both smaller and larger specimens are present, but the majority are small, indicating that we are probably dealing with clupeids caught during spring or early summer. The relative contribution of other species to the total amount of finds is not in contradiction with the presumed catch in spring-early summer. Smelt and flounder, both occurring in the fish sample, are typical members of the estuarine spring assemblage. A sample taken during fall should be dominated by seabass, gobies and early juvenile stages from twaite shad on their migration to sea. Finally, it should be mentioned that, in North Sea estuaries, shrimp outnumber fishes. Both common shrimp and prawn species of the genus *Palaemonetes* are found in the entire brackish water area of estuaries, which explains the presence of natant decapod remains in the fish bone sample.

A precise geographical location for the production site of the Tienen fish sauce cannot be given. The type of environment described (soft bottomed, sheltered zones within an estuary) could well be found in the estuaries of the two main rivers in the coastal area nearest Tienen, i.e. the Scheldt and the Yser. However, during the Roman period the dune belt along the coast was also frequently interupted by tidal inlets (see the maps by Baeteman *et al.* in Thoen, 1987, and by Vos & van Heeringen, 1997), which could equally have provided suitable living conditions for the fish species found in the sauce. In northern Gaul, the production of the sauce required artificial heating as it could not be based upon the heat of the sun alone (as was the case in more southerly regions). This makes it probable that the fish sauce production was linked to the coastal salt production, which involved the burning of peat in order to extract the salt from the brine obtained by evaporating seawater. Indeed, sites that are traditionally labeled as salt production sites could well have also specialised in fish sauce production. Proof for this hypothesis will only be found by detailed sieving of suitable contexts at such coastal sites, a task, however, that was not undertaken during the former excavations of salt production sites along the Flemish coast (i.e., the sites at Raversijde, Zeebrugge and Leffinge, see Thoen, 1987).

Economically, the southern part of the (present-day) Netherlands seems to have been very important in terms of the production of commodities linked with salt. In the province of Zeeland, ovens have been found that are believed to have provided the heat necessary for the fermentation of fish sauce at our latitudes (Immerzeel, 1990). In addition, the find at Aardenburg of a dolium, that had contained 300 litres of fish sauce according to its inscriptions, is an indication for production in the area since vessels of this size are too heavy for long-distance trade (Bogaers, 1971). The numerous finds of votive altars, dedicated by merchants to the goddess Nehalennia to ask for a safe journey during seafaring, further document the importance of trade in salted fish products between Britain and Gaul (Bogaers, 1971).

Possible fish catching methods

The capture of large quantities of small fish in an estuarine environment is nowadays practised most successfully with two passive fishing techniques that use the tidal currents to catch fish. Firstly, fyke nets connected to a longitudinal net can be set at the low-water line and need to be checked every few days for their catch (Maes *et al*., 1997). Secondly, stow netting involves the use of two nets on both sides of a ship that is anchored (Breckling & Neudecker, 1994). The nets, which are stationary, can be set on or above the mudflats and are exposed to the tidal currents. Due to the fact that most fishing gear is made of perishable materials, the present knowledge on ancient fishing techniques is mainly based on evidence other than archaeological finds. A recent review of the literary and pictorial evidence for Roman fishing technology (Bekker-Nielsen, 2002) shows that net fishing from boats was practised and that stationary ground-nets were known. Although not considered very efficient today for the catch of small estuarine fish, various types of fish-traps or dragnets may have been used as well, so long as the mesh-sizes were small enough. In fact, the archaeological fish assemblage that was described here shows remarkable similarities to some modern fish samples. These were taken during spring, using a pelagic net in the oligohaline, soft bottom zone, of a holartic estuary (Maes, personal observation).

Local fish sauces in North-Western Europe

The consumption of Mediterranean fish sauces can be traced by amphora studies. Occasionally, bone samples have also produced evidence for

this practice (e.g., Curtis, 1991). Besides the evidence for the 'genuine' Mediterranean fish sauce, there are now more and more archaeozoological data indicating the existence of local variants. This is the case for the Red Sea area and also for the North Sea (for a recent summary of bone finds see Van Neer & Ervynck, 2004: 208-209). Evidence is now available for five sites indicating the consumption or production of local fish sauces in Belgium and Great Britain (Table 5). In all of them the major components are herring and sprat. The finds from Peninsular House in London (Bateman & Locker, 1982) are of particular interest, since they provide evidence for a fish processing plant that may have been active from the mid-second to the early fourth century AD. The herring and sprat found at the site were all smaller than 8 cm TL and are believed to represent local catch from the Thames estuary. Jones (1988) described a late Roman or early post-Roman context at St Mary Bishophill Junior in York with abundant finds of small herring and sprat that has many features in common with the Peninsular House site. Although Bishophill is located farther from the river and clupeids would need to be imported, Jones (1988) believes that this site may also have been a production plant for fish sauce. Similar sites where production of fish sauce may have been organised are unknown from Belgium, but three consumer sites are known that are all located inland (Figure 1). The assemblage from Tienen, described in detail in this paper, dated to the mid-2nd c. AD and consisting of a very large concentration of bones, suggests that we are dealing with the remains of the stored product rather than with table refuse. The finds were not associated with pottery that may have contained the fish sauce. For this reason, but also because it is not excluded that wooden barrels were used for the storage, it remains unclear how the fish bones were deposited. Possibly we are dealing with a fish product that was spoiled and that was therefore discarded? Another context in Tienen that produced remains of fish sauce is the filling of a large refuse pit dated to the second half of the 3rd c. AD and associated with a temple dedicated to the god Mithras (Lentacker *et al*., 2004). Here the fish remains can safely be classified as consumption refuse from a banquet. The small sample of fish remains from Braives (Van Neer & Lentacker, 1994) was found in the basal filling of a well dated to the 3rd c. AD. A few amphora sherds were also found in the well, but it is unclear whether the fish bones were initially adhering to one of the amphora fragments, or whether they represent consumption refuse. The fish sauce from Braives mainly consists of clupeids, but the additional taxa (whiting, stickleback, smelt, sandeel) show that the composition of the sauce was very similar to the one from Tienen. This assemblage from Braives was initially described as being derived from the coastal area of the north-eastern Atlantic, probably the North Sea or the English Channel. However, because of the similarities to the fish fauna from Tienen, it is now believed that it may also have been produced along an estuary or tidal inlet with soft bottomed, sheltered zones.

The assemblage described in this paper is additional evidence for the consumption of fish sauce that was produced in the northwestern part of the Roman Empire. The dating of the finds in Belgium and Britain are consistent with the view that production of local variants occurred from the mid-second century AD onwards when the import of the 'genuine' Mediterranean fish sauce started to slow down, as suggested by amphora studies (Martin-Kilcher, 1990). The question remains, however, whether the import of the Mediterranean product declined because of the start of an independent production in northern Gaul, or whether the northern production was necessitated by an insufficient supply of the southern fish sauce. In any case, the growing evidence for the consumption of the local sauce indicates that this commodity must have been economically important.

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