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Research Article

Cuisine and culture-contact: lipid residue analysis reveals lack of aquatic products in pottery from Viking Age England

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Diet and material culture are interlinked, and examination of organic residues in ceramic vessels permits the simultaneous study of both; exemplified here in the analysis of early-medieval pottery from England and Denmark for biomarkers indicative of fish processing, a possible dietary indicator of Scandinavian migration during the Viking Age (*c.* AD 793–1066). While almost a quarter of sampled Danish pots were used to cook fish, diagnostic aquatic markers were securely identified in only 13 of 298 English vessels. Geographic homogeneity and temporal persistence in processing terrestrial animal fats instead suggest that Scandinavian settlers pragmatically conformed to Anglo-Saxon culinary traditions.

Keywords: Britain & Ireland, Viking, early medieval, organic residue analysis, pottery, food, fish

Introduction

In moments of culture-contact, diet and material culture are fundamental elements of identity-making. In early-medieval Europe (*c.* AD 400–1100), the significance of fish to the Scandinavian diet (relative to other parts of northern and western Europe) is frequently remarked upon, and the appearance of individuals with marine-heavy diets in Viking Age Britain (*c.* AD 793–1066) has been taken as an indicator of 'viking' migration (e.g. Barrett & Richards 2004; Pollard *et al.* 2012; Buckberry *et al.* 2014;

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Montgomery *et al.* 2014). Furthermore, from *c.* AD 1000, faunal data from England indicate an increase in the consumption of marine fish, related to a rapid intensification of deep-sea fishing and an associated trade in stored fish. This phenomenon has become known as the Fish Event Horizon (e.g. Barrett *et al.* 2004; Barrett 2018). Concurrently, variation in culinary material culture is apparent, with ceramics more widely used for cooking in first millennium England than in Scandinavia.

However, much of our understanding of the role of marine products in Viking Age diet has emerged not from pottery, but from fish remains and the isotopic analysis of human remains. Against this backdrop, we demonstrate how lipid analysis of ceramic cooking vessels can enhance our understanding of Viking Age fish processing. We consider the degree to which the practice was spatially and chronologically variable, and what happened when a group of ichthyophagic migrants settled in new communities and encountered complex ceramic repertoires. Were fish—perhaps previously grilled, smoked, baked or stewed in steatite/metal vessels—now incorporated into dishes that used these new ceramic technologies? In this context of conflict, migration and settlement, we explore the role played by cooking technologies in cultural accommodation.

Fish, pots and cooking in Scandinavia

Faunal remains and isotopic analyses of human bones demonstrate that fish was consumed in quantity in Scandinavia and many of its Viking Age colonies. Key contributors to fishbone assemblages include members of the cod (*Gadidae*) and herring (*Clupeidae*) families (e.g. Enghoff 1999: 52–3; Perdikaris 1999; Barrett *et al.* 1999; Wigh 2001: tab. 6), although quantitative comparison is frequently confounded by differential taphonomy, recovery and species visibility (e.g. Jones in O'Connor 1989: 197).

In Norway, zooarchaeological analyses indicate that gadid exploitation pre-dates the Viking Age (Perdikaris 1999; Perdikaris *et al.* 2007), with increases in the representation of marine species in the eighth/ninth century interpreted in relation to the growing importance of fishing (e.g. Naumann *et al.* 2014; Garnier & Vedeler 2021). In Sweden and the Baltic, although difficult to quantify (Craig *et al.* 2013), isotopic evidence suggests that diet was less dominated by marine foods (e.g. Kosiba *et al.* 2007; Olsson & Isaksson 2008; Kjellström *et al.* 2009), and elevated marine intake may have been status related (Linderholm *et al.* 2008). In southern Scandinavia—traditionally viewed as an important area of origin for the settlement of England—the picture is complex. Viking Age populations in Aarhus (Jutland) and Galgedil (Funen) seem to have been reliant on meat from terrestrial animals, though their diets also included a range of freshwater and marine resources; at Galgedil there was greater isotopic variation in males than in females (Price *et al.* 2014; Swenson 2019).

Culinary technologies in Viking Age Norway were aceramic, with vessels manufactured from soapstone (Hansen & Storemyr 2017). Chemical investigations into the uses of cooking equipment have been limited, though marine residues were recently detected in medieval vessels and bakestones (Garnier & Vedeler 2021; Wickler 2024). Sweden's ceramic culture during this period incorporated local traditions and Slavic introductions (Roslund 2007), and chemical analyses suggest significant diversity in diet, with residues

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at some sites depleted in marine products relative to human-bone isotopes (e.g. Olsson & Isaksson 2008; Isaksson 2009, 2010). In Denmark, locally produced pottery was largely hand-thrown and bonfire-fired (Madsen 1991: 232–34). Prior to this study, few analyses of organic residues from vessels found in Viking Age contexts from Denmark had been undertaken (though see Madsen & Sindbæk 2014: 216).

Fish, pots and cooking in Anglo-Saxon and Viking Age England

In England, ichthyological remains suggest a low baseline of fish consumption prior to *c*. AD 1000 (Barrett *et al*. 2004), followed by an increase in the exploitation of marine relative to freshwater fish (e.g. York; O'Connor 1989: 196; Harland *et al*. 2016). Outside of urban centres, fish remains from Anglo-Saxon and Viking Age contexts are rare, even in sieved assemblages (Dobney *et al*. 2007: 228–31).

Studies of the human-bone isotope record from Viking Age contexts in Atlantic Scotland (e.g. Barrett & Richards 2004; Montgomery *et al*. 2014) have identified elevated marine intake comparable to that seen in parts of Norway (e.g. Naumann *et al*. 2014). To date, there is little evidence for a similar elevation in pre-Viking or Viking Age England (e.g. Buckberry *et al*. 2014; Barrett 2018), and documentary sources suggest that fish consumption may have had status associations long before the Norman Conquest in 1066 (e.g. Fleming 2001: 5–6). In this context, the arrival of migrants steeped in maritime economy should be discernible (e.g. Jarman *et al*. 2018; Leggett & Lambert 2022: 28).

However, we know little about fish processing in early-medieval England, or whether cooking technologies changed under the influence of Scandinavian settlement. While some regions were effectively aceramic in the Middle Saxon period (*c*. AD 650–793), the seventh century saw the establishment of a significant pottery industry at Ipswich, with other regional industries following over the next century or so (Mainman 2020: 65). By the ninth century, the areas of northern and eastern England into which Scandinavians settled were characterised by widespread use of ceramics.

A new approach

There is a need to understand the role played by marine resources in Anglo-Scandinavian cuisine, as patterning in exploitation may contribute substantially to the study of culture contact. Hybridity and acculturation are recognised in diverse sources—from artefacts and burial customs to linguistics and law—complicating the identification of individuals who migrated from Scandinavia to Viking Age England (e.g. Hadley & Richards 2000).

Here, we exploit a new line of evidence—the use of domestic cooking pots—to explore potential changes in diet at high resolution. Pottery use reflects culinary choices and may tell us how past communities valued different foodstuffs. Determining the use of domestic containers through residue analysis is an archaeologically well-established method; lipid biomarkers associated with aquatic processing are well described and frequently identified in prehistoric vessels (Cramp & Evershed 2014; Bondetti *et al*. 2021). In a recent study of pottery use in the island communities of Atlantic Scotland, Norse

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period (*c.* AD 1100–1300) pots at Jarlshof, Shetland showed evidence of use in the intensive processing of marine products, while at Bornais, South Uist, the proportion of pots containing aquatic biomarkers did not increase substantially between the Iron Age (*c.* AD 400–800) and Norse (*c.* AD 900–1400) periods (Cramp *et al.* 2014). However, the island communities from which these samples were drawn are unlikely to be representative of other parts of Britain.

We expand this approach to a much larger sample of pottery from diverse urban and rural contexts, across ninth- to eleventh-century England (n = 298, Table S1), including sites both within and beyond the area traditionally seen as the focus of Scandinavian settlement (Figure 1). Sites were selected for their secure stratigraphy and ceramic sequences, and provide a transect across the northern Danelaw (Yorkshire, Lincolnshire and Nottinghamshire) together with a comparative sample from later Anglo-Saxon London. In each urban centre (York, Lincoln and London), we sampled from two sites—one central to the settlement and one more peripheral—to discern any intra-settlement variation. These data are compared with data from previously published Anglo-Saxon pottery and newly analysed samples from the Danish urban centres of Aarhus (n = 39) and Ribe (n = 18).

Materials and methods

Examined vessels include jars (potentially including domestic cooking pots and storage jars) (n = 212), bowls (n = 86), pitchers (n = 14) and unspecified categories (n = 43), and incorporate diverse regional wares and fabrics (Table S1). We deployed an approach that incorporates two independent lines of evidence for the identification of aquatic animal resources, taken here to include fish, aquatic molluscs and aquatic mammals, in the analysis of powdered ceramic samples (details in online supplementary material (OSM)). First, we measured the carbon isotope values ($\delta^{13}C$) of individual saturated fatty acids (*n*-alkanoic acids) with 16 and 18 carbon atoms ($C_{16:0}$; $C_{18:0}$) released from the pots during extraction, and compared these with reference marine and freshwater fish oils (the former are expected to be enriched in ^{13}C, while the latter are depleted in ^{13}C; Cramp & Evershed 2014). As $C_{16:0}$ and $C_{18:0}$ fatty acids are routinely identified in archaeological pottery, this means of differentiation has the advantage of being applicable to a wide range of material. However, when aquatic products are mixed with other resources—either sequentially or concurrently—the resulting $\delta^{13}C$ values are often more difficult to interpret. A second approach largely circumvents this issue by using the presence/absence of biomarkers for aquatic oils, including vicinal dihydroxy acids, isoprenoid fatty acids and ω-(o-alkylphenyl) alkanoic acids (APAAs; Cramp & Evershed 2014). We focused on the latter two criteria. APAAs are readily formed during protracted heating of polyunsaturated fatty acids (PUFA), which are abundant in fish oils, providing unequivocal evidence of fish processing (Bondetti *et al.* 2021). We define the presence of aquatic-derived oils according to the following criteria: the presence of either C_{20} and C_{22} APAAs and at least one isoprenoid fatty acid (Cramp & Evershed 2014); or C_{20} APAAs in a ratio of C_{18}/C_{20} APAA <0.06 and at least one isoprenoid fatty acid (Bondetti *et al.* 2021).

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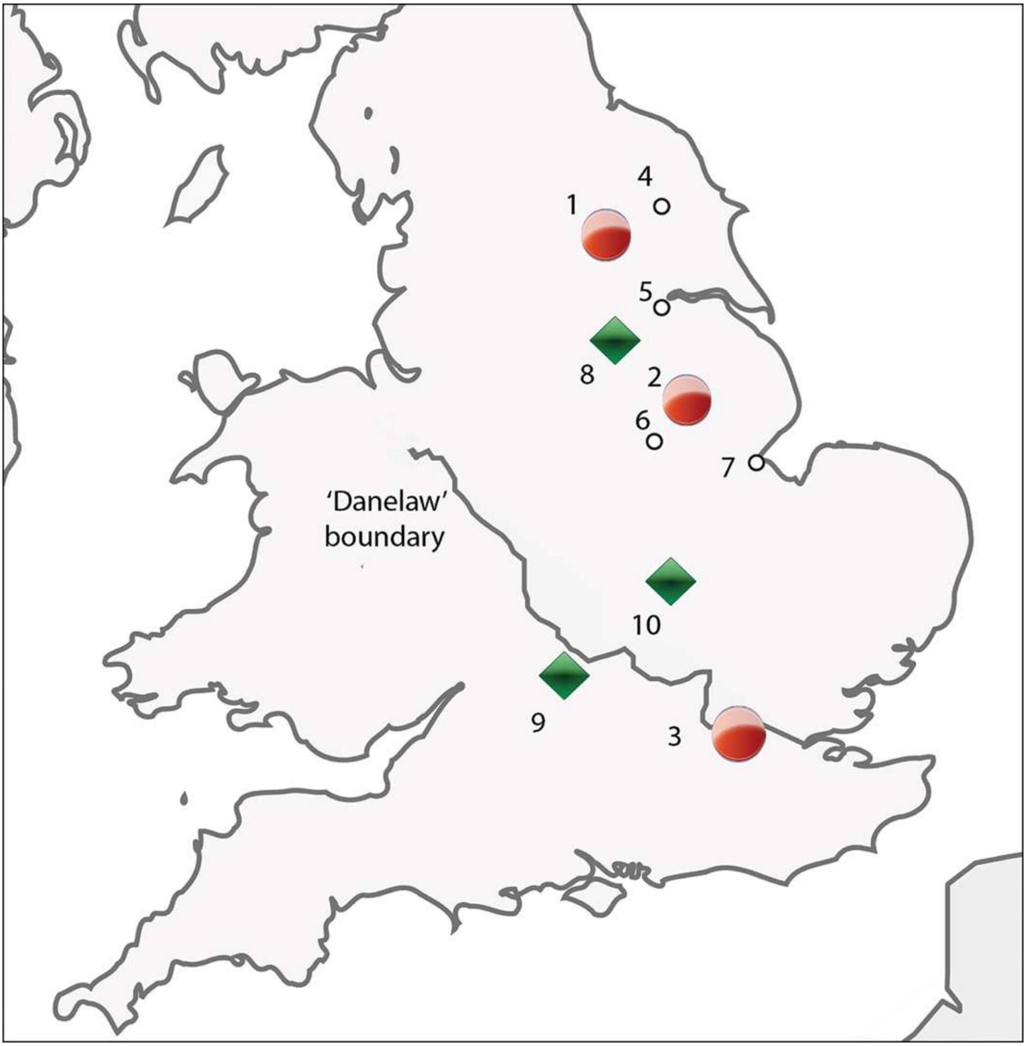

Figure 1. Map of sites included in the study. Surveyed urban sites (large red circles): 1) York (Coppergate; Hungate); 2) Lincoln (Flaxengate; Holmes Grain Warehouse); 3) London (Guildhall Yard; Plantation Place). Surveyed rural sites (small white circles): 4) Wharram (South Manor); 5) West Halton; 6) Newark Castle; 7) Fishtoft (White House Lane). Published comparator sites (green diamonds): 8) Flixborough (Colonese et al. *2017); 9) Oxford (multiple city centre sites; Craig-Atkins* et al. *2020); 10) West Cotton, Northamptonshire (Dunne* et al. *2020). The 'Danelaw' boundary of the Alfred-Guthrum Treaty is provided as a point of reference regarding the extent of Scandinavian settlement echoed in the distribution of Old Norse placenames; it should not be assumed that this constituted a formal border (figure by authors).*

Results and discussion

Most of the analysed pots produced lipid profiles dominated by saturated mid-chain-length fatty acids typical of animal fats. Of 355 samples, 270 provided sufficient quantities of $C_{16:0}$ and $C_{18:0}$ fatty acids for GC-c-IRMS (gas chromatography-combustion-isotope ratio mass spectrometry) analysis. Occasionally, lipid profiles potentially

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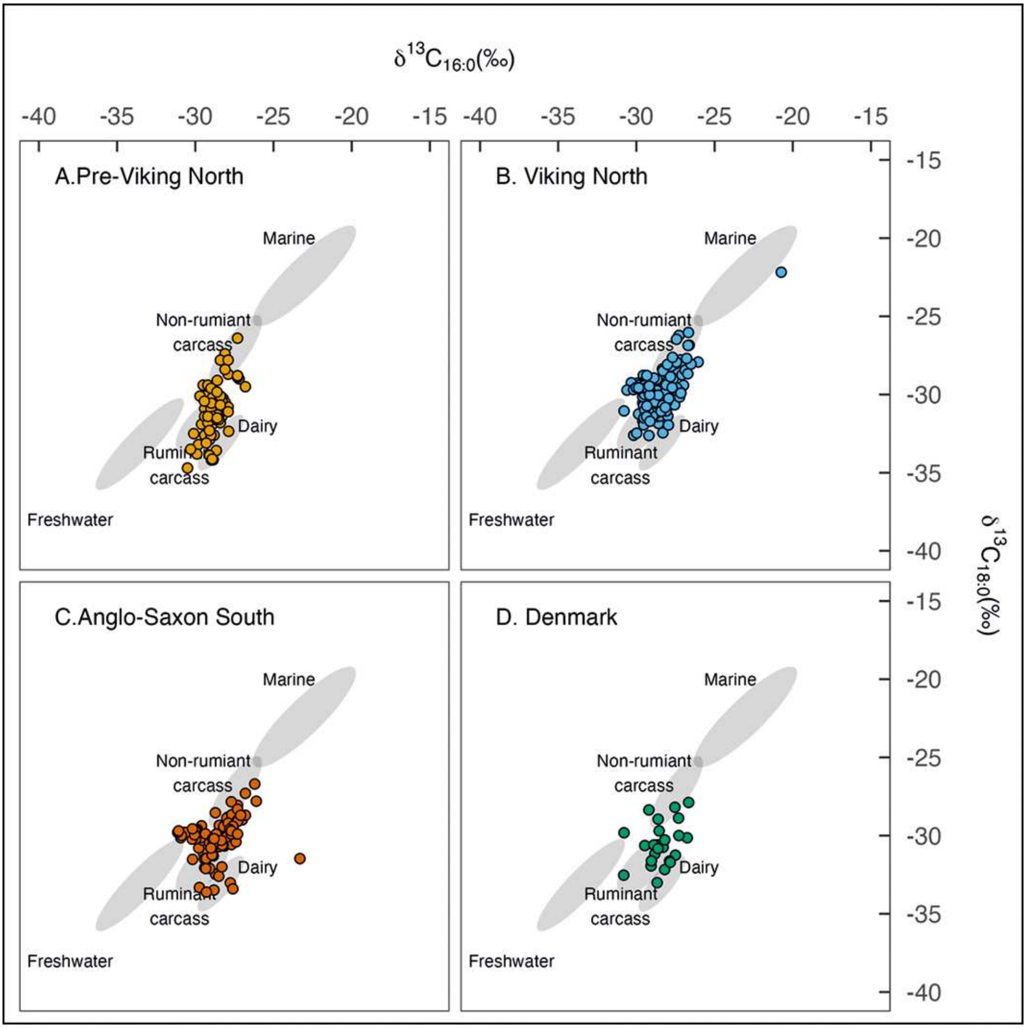

Figure 2. Plot of stable carbon isotope values ($\delta^{13}C$) of $C_{16:0}$ and $C_{18:0}$ fatty acids extracted from early-medieval potsherds from England and Denmark, compared by context. The data are plotted against reference ellipses (67% confidence) derived from 315 measurements of authentic reference products, corrected for the addition of post-industrial carbon (figure by authors).

derived from degraded plant waxes and oils were identified as additional components, but further elucidation of these compounds using high-temperature gas chromatography mass spectrometry is required, and will be reported separately. The presence/absence of these compounds does not affect our ability to identify aquatic-derived products.

A dataset from the carbon-isotope analysis of $C_{16:0}$ and $C_{18:0}$ fatty acids was assembled to include the new measurements reported here, and those previously reported from Anglo-Saxon contexts at Flixborough (Lincolnshire), West Cotton (Northamptonshire) and Oxford (Colonese *et al.* 2017; Craig-Atkins *et al.* 2020; Dunne *et al.* 2020). Few of the analysed samples provided fatty-acid values that plot within the ranges of modern marine or freshwater fish oils (Figure 2). There are no discernible differences in values

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between sites situated in northern England (where Scandinavian placenames are numerous) and those in ostensibly Anglo-Saxon London. Considering the $\delta^{13}C$ value of the $C_{16:0}$ saturated fatty acid—the dominant fatty acid in aquatic oils and therefore the one least affected by mixing—only two vessels (Coppergate – CP27, Newark – New32) produced values within the expected marine range (i.e. <-25‰), and only three vessels (Newark – New25, London – PL25, PL 26) produced values within the anticipated range for freshwater organisms (>-31‰), although the latter also overlaps the $\delta^{13}C_{16:0}$ for C_3 plants (Drieu *et al.* 2021). For comparison, over 60 per cent of Norse (medieval) ceramic vessels analysed from Jarlshof, Shetland, had $C_{16:0}$ values within the marine range (Cramp *et al.* 2015). Instead, the isotope data reported here overwhelmingly reflect mixtures of terrestrial animal fats, with nearly all samples plotting in the space between ruminant dairy (e.g. milk/yoghurts/butter), ruminant carcass fats (e.g. sheep/goat/cattle/deer) and non-ruminant carcass fats (e.g. pig/poultry). This is consistent with previous studies of Anglo-Saxon pottery (Colonese *et al.* 2017; Craig-Atkins *et al.* 2020; Dunne *et al.* 2020). Mixtures involving ruminant animals and (particularly) dairy fats tend to result in more negative $\Delta^{13}C$ values (defined by $\delta^{13}C_{18:0}$ minus $\delta^{13}C_{16:0}$). Dairy fats were slightly more prevalent at rural sites and, overall, the distribution of $\Delta^{13}C$ values was significantly different between rural and urban sites, with the former having more negative values (Kruskal–Wallis chi-squared = 10.464, df = 1, p-value = 0.001217).

Even if the majority of lipids were derived from terrestrial animal sources, aquatic-derived lipids (biomarkers) may still be present, reflecting a minor contribution of freshwater or marine foods to the residue. For example, in tenth- to fourteenth-century phases at the Norse settlements of Bornais and Cille Pheadair (Western Isles, Scotland), around 20 per cent of vessels contained long-chain APAAs with at least 20 carbon atoms (C_{20}AAPAA or C_{22}-APAAs), despite having $C_{16:0}$ and $C_{18:0}$ fatty acid values largely indicative of ruminant fats (Cramp *et al.* 2014). The evidence from Viking Age England provides a stark contrast. From the total dataset (n = 298), only two samples—from a context at Guildhall Yard, London, dated to after *c.* AD 1050 (GHY 12, 22)—contained appreciable amounts of long-chain C_{20}- and C_{22}-APAAs (Figure 3), and only a further 11 samples contain C_{20}APAAs and isoprenoid fatty acids, meeting the less stringent criteria for aquatic lipid identification (after Bondetti *et al.* 2021). Overall, only 4.4 per cent of vessels from England contained evidence of aquatic products: 3.5 per cent in Viking Age vessels and 7.1 per cent in pre-Viking vessels.

Shorter chain C_{18}-APAAs were present at relatively high abundance in 34 per cent of samples (Table 1) from all the sites in England, suggesting there was nothing to preclude the formation of APAAs in pottery from this period. While the C_{18} homologues are always found at higher concentrations than C_{20}-APAAs in heated aquatic oils—typically five times greater (Bondetti *et al.* 2021)—the general lack of C_{20}-APAAs in most samples suggests that, rather than an artefact of proportion, the C_{18}-APAAs were more likely formed during the heating of shorter chain ($C_{18:x}$) polyunsaturated fatty acids present in terrestrial plant and animal tissues (Bondetti *et al.* 2021), which is consistent with their isomeric distribution. In most samples, the ratio of E/H isomers of the

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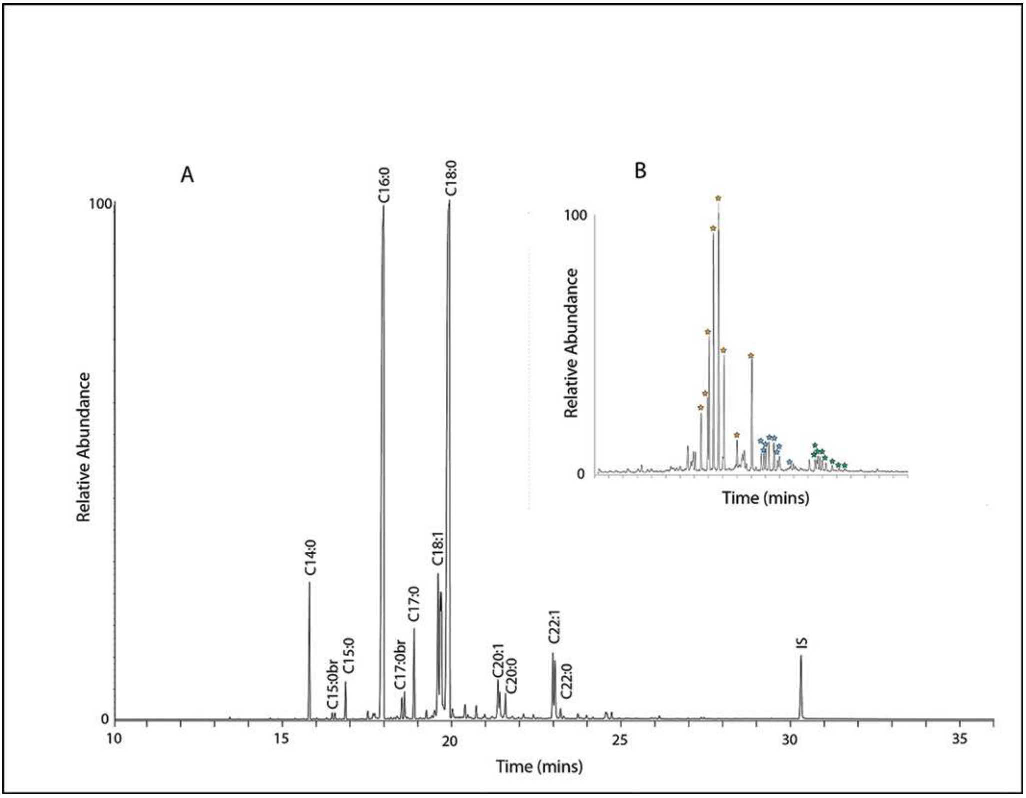

Figure 3. A) Partial gas chromatogram of an acid-methanol extract from Guildhall Yard, London (GHY12_200) showing principal fatty acids most likely derived from a mixture of terrestrial animal fats and aquatic oils; B) Partial ion chromatogram (m/z 105) showing a rare example of long-chain APAAs detected in GHY12_200, derived from heating aquatic oils (orange stars: C_{18}APAAs; blue stars: C_{20}APAAs; green stars: C_{22}APAAs) (figure by authors).

C_{18}-APAAs (Table S1) is consistent with leafy plants rather than cereals, although lower values can also be produced through prolonged heating (Bondetti *et al.* 2021). The presence of C_{18}-APAAs is also frequently observed (58%) in vessels from Aarhus and Ribe (Table 1), where, in contrast to the evidence from England, around 23 per cent of the vessels analysed contained aquatic-derived residues.

The paucity of aquatic lipids in vessels from England is remarkably consistent. Our sampling strategy incorporated jars of various sizes, pitchers and bowls, incorporating vessels manufactured in more than 15 fabric types (including widely distributed wares and local, short-lived varieties). We sampled material dated to the ninth, tenth and eleventh centuries; from northern, central and southern England; from rural settlements such as Wharram, and from peripheral and centrally located sites in the towns of York, Lincoln and London. None of these parameters was associated with any significant difference in the detection of aquatic lipids in pottery (Table 1), which appears to be independent of chronology, settlement character and geography.

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Table 1. Frequencies of heating and aquatic biomarkers inferred from presence of APAAs extracted from early-medieval potsherds from England and Denmark.

Site	Town/Region	Character	Date (centuries AD)	No. Analyses	Heating biomarkers	Aquatic biomarkers
Flaxengate	Lincoln	Urban (central)	Late ninth–eleventh	66	6 (9%)	0 (0%)
Holmes Grain Warehouse	Lincoln	Urban (peripheral)	Late ninth–twelfth	17	2 (12%)	0 (0%)
Fishtoft	Lincolnshire	Rural	Late ninth–eleventh	12	6 (50%)	0 (0%)
Cowlam	Yorkshire	Rural	*c.* fifth–eighth	3	2 (67%)	0 (0%)
Plantation Place	London	Urban (central)	Tenth–eleventh	26	6 (23%)	1 (4%)
Guildhall Yard	London	Urban (peripheral)	Tenth–eleventh	25	15 (60%)	3 (12%)
Newark Castle	Newark, Nottinghamshire	Urban	Tenth–eleventh	36	8 (22%)	1 (3%)
West Halton	Lincolnshire	Rural	Tenth/eleventh	23	5 (22%)	0 (0%)
Coppergate	York	Urban (central)	Mid/late ninth–eleventh	33	19 (58%)	4 (12%)
Hungate	York	Urban (peripheral)	Tenth–eleventh	34	16 (47%)	2 (6%)
Wharram South Manor	Yorkshire	Rural	*c.* seventh–eleventh	23	16 (70%)	2 (9%)
Ribe, Posthuset	Denmark	Urban (central)	Eighth–ninth	18	14 (78%)	5 (28%)
Aarhus	Denmark	Urban (central)	Tenth	39	19 (49%)	8 (21%)
Total (England)				**298**	**101 (34%)**	**13 (4%)**
Total (Denmark)				**57**	**33 (58%)**	**13 (23%)**

Heating biomarkers are defined by the detection of C_{18}-APAAs, while aquatic biomarkers additionally have appreciable amounts of C_{20}-APAA. Many of the sites are multiperiod; to ensure samples were taken from well-dated material, we targeted well-dated wares, focused on illustrated examples that preserved diagnostic morphology and, wherever possible, sampled sherds from sealed, well-dated contexts. See Table S1 for details.

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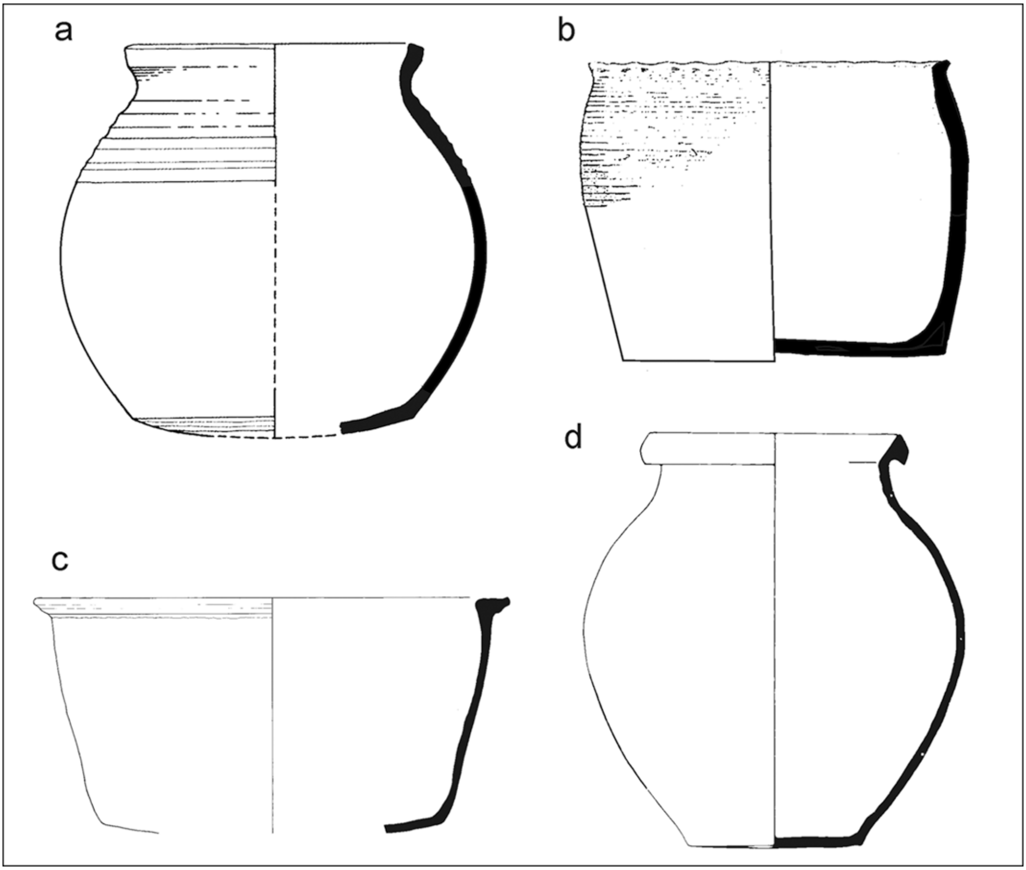

Figure 4. Middle Anglo-Saxon and Anglo-Scandinavian pottery forms: a) Ipswich Ware jar; b) Maxey Ware jar; c) Torksey Ware bowl; d) Stamford Ware jar (drawings by G. Perry, after: a) Blinkhorn 2012: fig. 12; b) Addyman et al. *1964: fig. 14; c) Hadley* et al. *2023: fig. 12; d) Kilmurry 1980: fig. 7, not to scale).*

Vikings, fish and the ceramic revolution

Late-ninth-century England saw a ceramic revolution (Figure 4), with the introduction of a range of high-fired, wheel-turned vessels of standardised form in the wake of the Viking Great Army's campaigns (e.g. Hurst 1965; Kilmurry 1977; Mainman 1990, 2020; Perry 2016, 2026). Yet, the appearance of this new ceramic repertoire does not seem to have had a discernible impact on the inclusion/exclusion of fish products from the vessels (Figure 2). Neither vessels of these new forms nor their Anglo-Saxon precursors contain an appreciable number of aquatic-derived residues (Table S1; Colonese *et al.* 2017). This also appears to be true of ceramics in central and southern England, where evidence for Scandinavian settlement is less pronounced (e.g. Craig-Atkins *et al.* 2020; Dunne *et al.* 2019, 2020). The data from Aarhus/Ribe are consistent with aristocratic sites in Sweden, which do preserve evidence for the use of ceramic vessels in fish processing, though this evidence is under-represented relative to expectations based on

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Figure 5. A tenth-century iron pan from excavations at 16–24 Coppergate, York (photograph by York Archaeological Trust, CC BY-NC 4.0).

isotopic analyses of human bone (Olsson & Isaksson 2008). Few comparative data are available from Viking Age Norway, where organic residue analysis studies have been rare (Wickler 2024: 176), but the differences between results from England and Denmark—typically seen as the homeland of many of England's Viking Age settlers—are notable.

Fish (including marine species, at a low level) are present in zooarchaeological assemblages from Viking Age towns in England, so this discrepancy between pottery use and faunal data could relate, in part, to the cooking of meats in socially prescribed ways. It is possible that the consumption of fish was an aristocratic privilege as early as the Viking Age (e.g. Fleming 2001: 5–6); at Birka, for example, male individuals buried with weapons tended to have more marine-rich diets (Linderholm *et al.* 2008), and there is evidence that a restricted number of individuals, possibly elites, had access to marine diets in early Viking Age Orkney (Barrett & Richards 2004). In Viking Age England, too, we might postulate a division between terrestrial meats and greens, which were commonly available and routinely stewed in pots, and fish, whose availability was more restricted and which may have been fried, grilled, baked or eaten raw, smoked or salted.

Indeed, there is some evidence that fish was cooked using non-ceramic technologies. Old English texts reference the broiling of fish (e.g. Herzfeld 1900: March 27), though the equipment used in this form of cooking is poorly represented in Viking Age collections. Aristocratic grave goods such as the Oseberg cauldron hint at metallic cooking wares as part of the repertoire (Petersen 1951: 369, 409; see also Graham-Campbell 1980: 15–20), and soapstone vessels were also important, but lipid extraction from this material has proven difficult (see Garnier & Vedeler 2021; Wickler 2024).

In England, soapstone vessels are present in early Viking Age settlement phases, and are best interpreted as possessions brought with the first wave of migrants (Sindbæk 2015). Metal vessels are rare and often fragmentary, though examples are demonstrable, such as the large pan from Coppergate, York (Ottaway 1992: 604–605; Figure 5). Osteoarchaeological evidence for fish-processing is similarly scarce. Transverse chopmarks on cod and salmon caudal vertebrae from late seventh- to early ninth-century phases at Flixborough may suggest the cutting of fish into steaks (Dobney *et al.* 2007: 109). Other assemblages lack cut-marks or any selective patterning in body part representation (e.g. Flaxengate, Lincoln; Wilkinson 1982), though butchery evidence from medieval York may indicate the sagittal splitting and filleting of cod (Harland *et al.* 2016: 194–96). More direct evidence for cooking is perhaps visible in the low-level burning of bones (e.g. Harland *et al.* 2016: 176–77), though this might equally reflect disposal methods. A survey of fish remains from Anglo-Saxon and Viking Age sites in England provides little further data.

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Figure 6. A representation of fish at the banqueting table: scene 43 from the Bayeux Tapestry (*detail of the official digital representation of the Bayeux Tapestry – eleventh century; City of Bayeux, DRAC Normandie, University of Caen Normandie, CNRS, Ensicaen, photos: 2017 – La Fabrique de patrimoines en Normandie*).

The eleventh-century Bayeux Tapestry shows a variety of food being cooked on spits and braziers, as well as the use of a large cauldron, but fish are only depicted whole, at Bishop Odo's table (Figure 6). While this scene is probably an allusion to the biblical Last Supper (Gameson 1997: 74–75), it is consistent with suggestions regarding the status and ecclesiastical associations of fish, and with their processing being undertaken aceramically. Altogether, the artefactual, zooarchaeological and illustrative material for the consumption of fish is sparse, but the lack of diagnostic residues in pots is strong evidence that when eaten in Viking Age England, fish must have been prepared by non-ceramic means.

Fish, pots, identity

Migration and settlement are often marked by culinary change, whether through transformation or hybridisation (e.g. Barrett & Richards 2004; Holmes 2015; Hamilakis 2021). What is often taken as the most distinctive marker of 'viking' culinary identity—fish—does not appear to have made a substantial imprint on the material culture of Anglo-Saxon England. Instead, the culinary habits of communities living in pre-Viking and Viking Age England share remarkable similarities in relation to aquatic products, in contrast to what is seen in pre-Viking and Viking Age southern Scandinavia (Figure 2).

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In the context of the late-ninth-century rapid, widespread adoption of an entirely new ceramic repertoire, the absence of appreciable differences in vessel contents across pre-Viking and Viking Age phases is striking. It is possible that adoption of local food technologies helped to ease Scandinavian integration into the Anglo-Saxon milieu. Food is central in identity-making, particularly in contexts of migration and culture contact, and potentially provides better access to private, less-conspicuous display than more archaeologically obvious markers such as architecture and dress accessories. The apparent adoption of native approaches to the use of ceramics is thus instructive.

Moreover, there is little evidence for changes in pottery use after the end of the tenth century and the Fish Event Horizon. This horizon is marked, across northern Europe, by the appearance of increased quantities of fish bones in coastal middens, a new focus on deepwater marine fish (particularly large gadids) and distinctive patterns in butchery marks and body-part representation (e.g. Barrett *et al.* 1999; Orton *et al.* 2014). However, only two of the 27 pots from our sample that clearly date beyond AD 1000 contain aquatic biomarkers, consistent with results from smaller organic residue studies in medieval Oxford and West Cotton, Northants (Dunne *et al.* 2019; Craig-Atkins *et al.* 2020: 4–8). The changes observed in fishbone assemblages during this time must therefore reflect foods prepared and consumed using aceramic methods. Larger changes in diet came later in the Middle Ages (Harland *et al.* 2016), as the importation of stock-fish to towns such as York made marine fish more accessible.

Conclusion

In Viking Age England, fish were not routinely processed using ceramic cooking pots, suggesting that the ninth-century arrival of Scandinavians in England did not result in observable change in ceramic use. Anglo-Scandinavian communities quickly adopted a new range of continental ceramics, but culinary conservatism appears to have discouraged their use in processing fish. This practice seems homogeneous across eastern England, marking a contrast with eighth- to tenth-century Denmark. The absence of evidence for Scandinavian influence on this aspect of Anglo-Saxon culinary technology echoes the long-discussed invisibility of Vikings in the material culture, settlement and funerary practice of Viking Age England (e.g. Hadley & Richards 2000) and provides a new line of evidence, arguably speaking more directly to private identities than to conspicuous display.

Data availability statement

Relevant ceramic and lipid data are provided in Table S1.

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Online supplementary material (OSM)

To view supplementary material for this article, please visit https://doi.org/10.15184/aqy.2026.10288 and select the supplementary materials tab.

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