VESSELS OF CHANGE

A long-term perspective on prehistoric pottery use in southern and eastern middle Sweden based on lipid residue analyses

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The analysis of lipid residues in prehistoric pottery has quite recently become an integrated tool in Swedish archaeology. As such it is an approach that has also been adopted in large rescue archaeology projects. This paper presents an attempt to compile the results of two such projects and shows how this new knowledge has contributed to research archaeology, especially in the form of new research projects. Suggestions for future research are also presented.

Key words: Food culture, lipid residues, pottery use, change, rescue archaeology, research archaeology

INTRODUCTION

This paper was originally presented at a workshop in 2005 at the Laboratory for Ceramic Research, Lund University. It is a first attempt to reflect on trends in pottery use, based on the analysis of lipid residues from a relatively large body of material spanning several prehistoric periods in Sweden. This has been made possible thanks to close collaborations with a number of agencies in the field of rescue archaeology, and some reflections on such collaborations will also be presented. But first I would like to put pottery use into its proper context: eating.

All animals need to eat. Some species eat more or less the entire time they are awake whereas others can go without food for weeks or months. Humans stand somewhere in between and usually eat a few times a day. Within about twelve hours since the last meal humans typically begin to feel hunger, and within approximately twenty hours the human body begins to adjust physiologically and enter a state commonly known as starvation. This is, however, not the end. A healthy and normally built person can survive at least six to eight weeks without any food at all (Granström 2004). But how individuals experience and react to the physiological adjustment to starvation varies enormously (Isaksson 2009a). Anyhow, to live with periods of prosperity altered by short periods of need has probably been quite a regular state of affairs throughout human history. But how the need for food has been accounted for in different cultural or historical contexts varies tremendously. Man is the only mammal of its size that has managed to chisel out a living from almost every environment on the planet. This has only been possible through culture.

Food and eating is something humans have engaged in heartily, preferably on a daily basis. Against this background it is perhaps not surprising that research concerning food culture, both theoretical and empirical such, can be found in many fields including anthropology, ethnology, sociology, education, history and archaeology (Barthes 1967; Lévi-Strauss 1978; Douglas & Isherwood 1979; Montanari 1994; Hill 1995; Dietler 1996; Beardsworth & Keil 1997; Counihan & van Esterik 1997; Dillman 1997; Isaksson 2000; Bringéus 2001; Eriksson 2003; Ashley *et al.* 2004; Goldstein *et al.* 2005; Stjerna 2007). Humans are in general omnivores, and the lists of things that have been considered food are massive (cf. Kiple & Ornelas 2000; Davidson 1999; Eidlitz 1971). But it is also typical that humans do not eat everything edible and available. Preferences of taste are cultural constructions, things we learn, and experiences of tastes (good or bad) are strong sensory impressions connected with moods and memories. Sharing these sentiments with others often provides strong feelings of unity, contributing to the group identity. Differences in patterns of food and eating may therefore serve as strong boundaries between all kinds of social and cultural groups.

To address such questions archaeologists may study the artefacts and features connected with cooking and eating found among settlement remains and grave-goods. More detailed studies may include osteological investigations of bones from food waste as well as analyses of plant macrofossils found in soil samples. Other information might be gathered through the analysis of food remains found adhering to and absorbed into ceramic vessels (*cf.* Evershed *et al.* 2001). Absorbed residues, which are the focus of this paper, provide a means to compare contributions from various foods (*e.g.* animals and plants) difficult to acquire in any other way, and also a means to get direct evidence of foods that leave few other traces (e.g. milk and many plants).

At archaeological sites, the structures, features, layers and artefacts associated with food and eating constitute the material remains of a whole range of culinary practices performed in a variable set of different food-cultural contexts (*cf.* Isaksson 2009b). Much of what is found in a settlement investigation may actually be connected with subsistence in one way or another: waste layers, hearths, pits, potsherds, bones, stone tools, buildings, fences, etc. The cultural aspects of food and eating have consequences for the evaluation of any of these subsistence-related materials, including data obtained by various technical analyses. Contextual considerations are significant for the selection of sampling strategies and analytical techniques as well as for interpretations of such data. Differences between social or cultural groups in these patterns of culinary practice may leave detectable traces. However, these signals may be very different depending on whether the culinary context where they are produced relates to food production, storage, preparation, representation or consumption. The culinary contextual comparability or consistency of records must be established as far as possible. With an awareness of culinary contexts it is possible to set data from different contexts against each other (*cf.* Isaksson *et al.* 2005; Olsson & Isaksson 2008). With such an integrated approach there is hope of catching the complexity and to begin to try and understand prehistoric cultures of food.

ORGANIC FOOD RESIDUES

The chemical analysis of organic food residues has quite recently become an integrated tool in archaeology (Evershed 2008a). In Sweden systematic analyses began in the early 1970s (Slytå & Arrhenius 1979) but it was not until the late 1990s and early 2000s that these kinds of approaches were incorporated into large-scale rescue archaeology projects, such as those at Kristineberg Syd and Oxie in Scania, southern Sweden (Fig. 1). And it was not until the E4 highway project through Uppland, central Sweden (Fig. 1), in the early 2000s that the analysis of organic residues was incorporated at an early stage of a project, with huge benefits especially regarding sampling strategies.

During use, prehistoric pottery often adsorbed fluids from the food or other products stored or processed in them. These fluids contain among other things lipids (fats, oils, waxes), which have been proved to survive relatively well over depositional time (*cf.* Evershed *et al.*

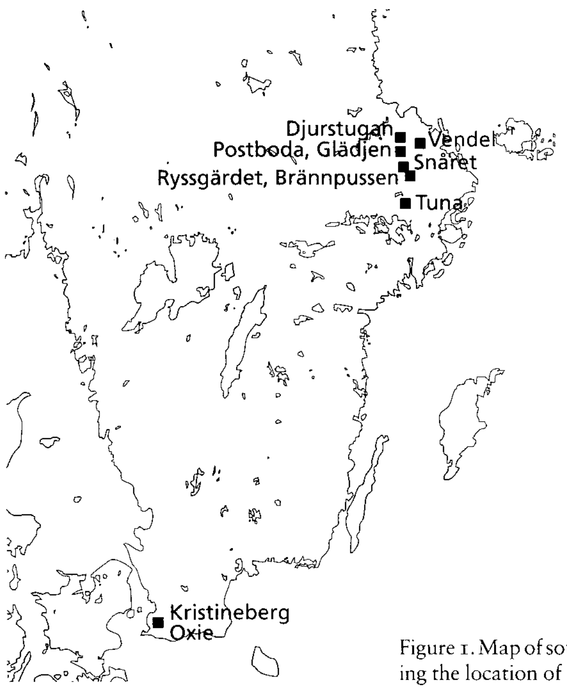

Figure 1. Map of southern and middle Sweden showing the location of the sites dealt with in this paper.

2001). The composition of these lipid residues depends on what has been processed in the pot and how; that is, it depends on pottery use. There is some evidence that lipids from the last few uses of the vessel will dominate the lipid residues extracted from prehistoric potsherds (Craig *et al.* 2004). However, experiments have shown that different foodstuffs leave signals of different strength and staying power (Isaksson *et al.* 2004:313–317; Olsson & Isaksson 2008:777; Evershed 2008b). Many lean foods leave negligible traces whereas the signal from others may survive many consecutive uses. Therefore there may be a range of varying time-depths in the specific lipid classes of any given residue, but different pottery uses will leave different lipid residues.

The compilation of results in this paper is based on samples from a total of 203 vessels. Of these vessels, 69 come from five Neolithic sites ranging in time from 3500 to 2300 BC. Most of these sites were seasonal and coastal settlements associated with the so-called Pitted Ware culture, but at the latest site the ceramics show parallels with late Battle Axe and Late Neolithic pottery. All the Neolithic sites are from eastern middle Sweden. The Bronze Age is represented by 45 vessels, 24 of which come from three Early/Middle Bronze Age sites in eastern middle Sweden and 21 from a single Late Bronze Age site in southern Sweden. The Iron Age is represented by 89 vessels: 14 from an Early Iron Age site in southern Sweden and 75 from four Late Iron Age sites in eastern middle Sweden.

Most of these potsherds were collected carefully already during excavation; they were never handled with bare hands, and they were wrapped in aluminium foil, bagged, tagged and stored in a freezer until analysed in order to avoid post-excavation changes and contamination. Potsherds from the rim and upper body were given priority as these have higher lipid content in general (*cf.* Charters *et al.* 1993).

The exact sample selection was in the hands of each site-director and some of the sites were sampled to answer site-specific questions rather than to provide a representative material. The sampling strategies vary among intra-site studies based on spatial organisation issues, vessel-size variations and the characterisation of certain contexts. There are also huge chronological and spatial gaps as well as painfully large differences in the sample sizes compared. Some of the rules of the statistical techniques applied (*i.e.* random samples and clearly defined populations) may therefore have been violated. All these problems are knowingly ignored; the comparisons presented in this paper are made in order to identify essential issues for future research rather than to provide any answers.

ANALYTICAL TECHNIQUE

From each potsherd a 1–3 g sample was ground off using a low-speed pottery grinder, after first removing the outer millimetre in order to avoid contamination from the soil. After adding an internal standard (n-hexatriacontane) lipids were extracted to a solvent (chloroform/methanol, 2:1) by means of sonication. The extract was transferred to a vial and the solvent removed by a gentle stream of nitrogen. The lipid residues were treated with bis(trimethylsilyl)trifluoracetamide with 1–10 % (v) chlorotrimethylsilane to produce trimethylsilyl derivatives and analysed by gas chromatography and mass spectrometry (GCMS). A more detailed description of the technique may be found elsewhere (*e.g.* Isaksson 2000; Olsson & Isaksson 2008).

INTERPRETATION

Archaeological lipid residues are complex mixtures of up to hundreds of components. A few of these are origin-specific biomarkers while others may derive from a limited number of different sources. The formation processes behind the lipid residues are complex, and they are affected qualitatively by different depositional environments. Except for extreme conditions the environmental effects seem to be quantitatively minor, as indicated by experiments (Hjulström & Isaksson 2005). Any significant differences between pottery assemblages in these measures are therefore strong indicators of a difference in pottery use. But to tell exactly what has been put in a pot may be difficult (Barnard et al. 2006) without any archaeological questions or perceptions of what was available in the cultural and historical context in question. The residues are the result of culture, as it is the choices of the users that determine what went into the pots and how they were used. More often then not there was more than one ingredient, adding to the chemical complexity of the residues. The interpretation of the precise pottery use is therefore in essence a case of the inference to the best explanation (cf. Harman 1965), with all its flaws. Moreover, there are many other culinary arts besides cooking in a pot, which is why lipid residues do not reflect the whole diet (Olsson & Isaksson 2008).

With the analytical technique that we apply it is possible to identify lipids from terrestrial animals, marine animals or fish, and from vegetables. It is also possible to get indications of lipids from ruminant animals and milk fat. The detection of cholesterol or any decomposition product of it is evidence for animal lipids. A high ratio (>0.5) of the fatty acids stearic (C18:0) to palmitic (C16:0) acid is indicative of a large contribution from terrestrial animal lipids (Isaksson 2000). Contributions from vegetables are detected by the presence of phytosterols, waxes or wax residues (long-chain fatty acids, alkanols and alkanes) (*cf.* Charters *et al.* 1997) or a low C18:0/C16:0-ratio. Certain polyunsaturated fatty acids may be transformed to ω-(o-alkylphenyl)alkanoic acids when heated (Matikainen *et al.* 2003). Vegetable oils are rich in C18 polyunsaturated acids, and C18 ω-(o-alkylphenyl)alkanoic acids are therefore an indication of this in a prehistoric sample. Marine animal oil residues are rich in C16-C20 ω-(o-alkylphenyl)alkanoic acids and should also contain two isoprenoic acids and have a low C18:0/C16:0-ratio (Hansel *et al.* 2004). Fish lipids may also leave traces in the form of a low C18:0/C16:0-ratio together with the presence of cholesterol (Olsson 2004). One of the two isoprenoic acids mentioned above, called phytanic acid, may also be produced through the decomposition of chlorophyll, indicating the presence of green vegetables. Milk lipids may be detected by the presence of a broad distribution of triacylglycerols. These compounds are, however, often decomposed and require favourable preservation conditions to survive. As an indication for ruminant lipids in general (from the animal or from milk) we use a ratio of the branched C17:0 fatty acids to C18:0 (*cf.* Hjulström *et al.* 2008:68). During use free fatty acids in the vessel wall may react and form long-chain ketones, but at temperatures higher than during normal cooking (Evershed *et al.* 1995; Evershed 2008b). But pottery may not only be used for food, but for the storage and processing of tars and pitches.

FROM THE NEOLITHIC TO THE EARLY/MIDDLE BRONZE AGE IN UPPLAND

This comparison includes three Bronze Age and five Neolithic pottery assemblages along Highway E4 through Uppland (Table 1), excavated by UV Uppsala (GAL) and SAU. The Neolithic material is exclusively from Pitted Ware sites, except at Djurstugan where there are parallels with late Battle Axe and late Neolithic pottery.

Neolithic		**Early/Middle Bronze Age**	
No. of samples: 69		No. of samples: 24	
Site	**Date**	**Site**	**Date**
Djurstugan	2300 BC	Glädjen	1500 BC
Brännpussen	2750 BC	Snåret	1700–800 BC
Postboda	3300 BC	Ryssgärdet	1400–800 BC
Snåret	3350 BC		
Högmossen	3500 BC		

Table 1. The sites along Highway E4 in Uppland (cf. Fig. 1) discussed in this paper (cf. Fontell & Jahn 2004; Syse 2005; Lindberg 2006; Ytterberg 2006; Sundström et al. 2006; Nilsson 2006; Björck & Larsson 2007; Hjärtner-Holdar et al. 2008; Björck & Hjärtner-Holdar 2008).

The distributions of pottery use in the Neolithic and Bronze Age assemblages are presented in figure 2. A χ^2-test shows that there is a significant difference between the distributions (χ^2=29.80, df=9, p=0.0008), indicating a significant change in pottery use between the two periods. The striking difference is the much more specialised pottery use in the Bronze Age material, dominated by vegetables and pine tars.

Excluding the Bronze Age tar pots, the lipid content in the Neolithic is higher than in the Bronze Age material but the reliability of the dif-

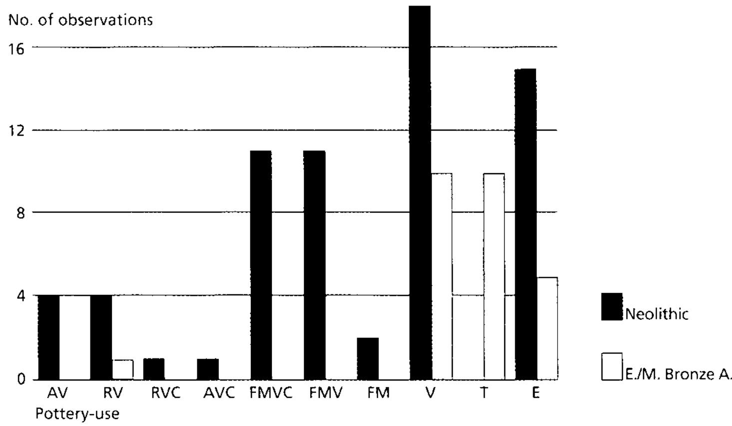

Figure 2. The distribution of pottery-use classifications of lipid residues from Neolithic and Bronze Age pottery (Table 1). Abbreviations of pottery-use classes: A= terrestrial animal, V=vegetables, R=ruminant (milk or from animal), C=condensation products (compounds formed during heating), FM=fish/ marine animal, T=tar, E=no lipid residues found.

ference is above the $p<0.05$ level ($F(1, 81)= 2.39$ $p=0.126$). This is due to the great variation in the Neolithic material, and a larger sample is needed to test this relation. In the Neolithic the ceramic seems to have been used for virtually everything, but in the Bronze Age the pottery use is practically limited to the storage (and probably processing) of vegetable foods, and of tar from pine.

The Pitted Ware culture has in early research been characterised as a rather homogeneous coastal hunter-gatherer culture with an emphasis on marine mammal hunting and fishing (cf. Löfstrand 1974). In the present material there are traces of marine/fish in about 35 % of the potsherds and of terrestrial animals in about 14 %, which may seem to corroborate the marine centre of attention. But there are traces of vegetables in about 72 % of the analysed potsherds, emphasising the importance of plants, nuts and tubers. There are also great variations and significant differences in pottery use both between and possibly within the Pitted Ware sites as well as changes over time. For example the Postboda site includes three adjacent sites and there are significant differences between all of them, be it qualitative or quantitative (Isaksson 2005a). One of the sites at Postboda has a pottery-use distribution that is actually more similar to the much later site of Brännpussen (Table 2), while another Postboda assemblage has a significantly different distribution ($\chi^2=14.28$, df=7, $p=0.046$) from the later site. This is indicative of a modulated and dynamic, rather than monotonous and static, culture of food within the Pitted Ware culture (*cf.* Brorsson *et al.* 2007).

If the very limited pottery use in the Bronze Age reflects the diet it would have been a very unbalanced one indeed. The change in pottery use from the Neolithic to the Bronze Age is rather the result of a change in the culinary arts, that is, the arts and techniques of food preparation. The Early Bronze Age of eastern middle Sweden saw the emergence of a new kind of ancient monument, namely heaps of fire-cracked stones. In early research these heaps were exclusively connected with the cooking of food (*e.g.* Almgren 1912; Ekholm 1921), and heated stones can be used for cooking in a number of ways, from cooking in pits to cooking in wooden or leather containers (Isaksson 1995). The emergence of the heaps in the Early Bronze Age may be explained by such a change in the culinary arts, but why this change would occur is yet to be understood. More recent interpretations of the features have put emphasis on possible ritual aspects of the heaps (*e.g.* Lundqvist 1991; Kaliff 1999). This is not necessarily in contradiction to an important functional aspect. A practical importance may rather be in support of a ritualised treatment of the waste produced from the practice.

Most of the vegetable lipid residues in the Bronze Age pottery derive from adipose tissue rather than waxes, possibly from cereals. This coincides in time with some of the earliest demarked fields and roughly also with the appearance of ploughing scenes in rock carvings. The milk residue, identified by a broad distribution of intact triacylglycerols, is found from the early Bronze Age (c. 1700–1500 BC) (Hjulstöm 2005). The impact of agriculture is clear in this period, and the changes in pottery use discussed above are certainly also connected with the establishment of a more settled agricultural lifestyle.

The large number of pots with traces of pine tar shows that destructive distillation of pine-wood was practised. But how this was done is still unknown. The earliest tar production features in eastern middle Sweden, and indeed in Europe, are radiocarbon dated to AD 240–540 (Hjulström *et al.* 2006). An alternative is the so-called double-pot technique, which requires a distillation pot with a hole in the bottom for the tar to run through, but to my knowledge there are no finds of such pots in the present material. Birch bark pitches have been produced in Scandinavia through destructive distillation since before the introduction of pottery (Aveling 1998). Birch bark pitch may have been used as incense in the Early Iron Age (Isaksson 2005b), and in the Late Iron

Age there are indications that birch bark pitches were closely associated with the ritual sphere and the pitches from pine or spruce with more profane, practical uses (Sandelin 1998). As to the use of the tar in the Bronze Age vessels, it is tempting to connect it with ships and seafaring and with the appearance of ships in rock carvings. The tar may also have been applied in order to seal the vessels.

FROM THE LATE BRONZE AGE TO THE EARLY IRON AGE IN SCANIA

This material was sampled during rescue excavations at two adjacent sites, Kristineberg Syd and Oxie in Scania (Fig. 1), under the direction of Malmö Kulturmiljö. The material consists of 21 samples from the Late Bronze Age and 14 samples from the Early Iron Age. Both periods are represented at both sites. There is no significant difference in the distribution of pottery uses (Fig. 3) between these two periods (χ^2=12.2, df=8, p=0.14).

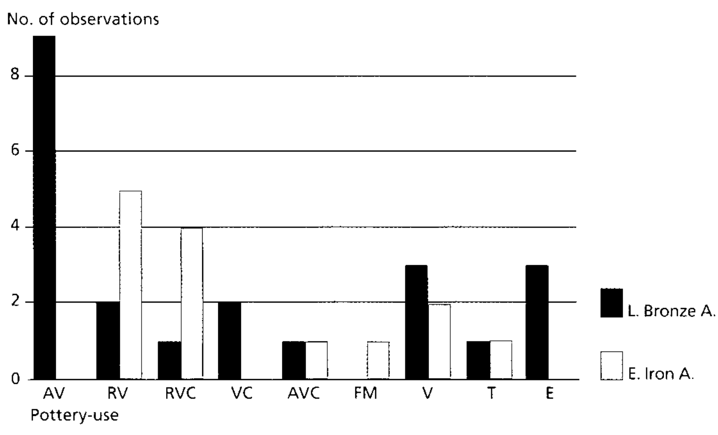

Figure 3. The distribution of pottery-use classifications (cf. Fig. 2) of lipid residues from the Late Bronze Age and Early Iron Age at Kristineberg Syd and Oxie, Scania.

But there is significantly (t =-3.18, df=33, p=0.0032) lower lipid residue contents in the Bronze Age material than in the material from the Early Iron Age. This is probably not due to the age difference and a higher degree of decomposition of the Bronze Age material, as the Neolithic material from Uppland also has higher amounts of lipid residues. If the pottery was more fragile in the Late Bronze Age a shorter life-time of the vessels could be an explanation. But the quality of pottery is generally better in the Late Bronze Age than in the Early Iron Age (Stilborg, personal communication), and the difference could therefore be assumed to be connected with pottery use.

In the Bronze Age material traces of C18 ω-(o-alkylphenyl)alkanoic acids were found in one sample and in the Iron Age material in six samples, a difference that also is significant (χ^2=7.62, df=1, p=0.0058). This is an indication of an increased use of oil-rich vegetables, such as flax, hemp or gold-of-pleasure (*cf.* Isaksson *et al.* 2005). Flax and gold-of-pleasure have been cultivated at least since the Late Bronze Age, and hemp was introduced in the Early Iron Age (Welinder 1998). This increased use of oil-rich plants may be the explanation to the higher lipid residue content in Early Iron Age material. A potential increase in indications of ruminant lipids may also contribute, if this includes secondary products such as butter.

LONG-TERM PERSPECTIVE ON POTTERY USE IN SWEDEN

In this comparison all the above samples are included, as well as analyses of 75 Late Iron Age samples from four sites in Uppland: two close to Vendel Church in Vendel Parish, one at Valsgärde in Gamla Uppsala Parish, and one at Tuna in Alsike Parish (Fig. 1) (Isaksson 2000; Olsson 2004; Isaksson *et al.* 2005; Hjulström & Isaksson 2005; Olsson & Isaksson 2008). In total the number of analysed potsherds included is 194, excluding the tar pots and concentrating on samples with food residues.

There are statistically significant differences in the amounts of lipid residues (Fig. 4) in pottery from different periods (F(4, 184) = 3.87, p = 0.0048). What seems consistent in both southern and middle Sweden is the low lipid residue content in the Bronze Age pottery. It seems unlikely that this is due to post-depositional degradation and is rather to be attributed to a deviating pottery use in this period. The lipid residue content is dependant on many variables such as what was introduced into the pot (lean or fat foods) and how the vessels were used (for cooking, storage or serving). A large range of lipid residue content is consequently indicative of a wide range of uses (Charters *et al.* 1993:220). The larger standard deviations of the Neolithic and Late Iron Age materials thus indicate a wider range of uses in these periods than in the intermediate ones.

A high C18:0/C16:0-ratio is indicative of a large contribution from terrestrial animal lipids (Fig. 5). There is a significant difference in this

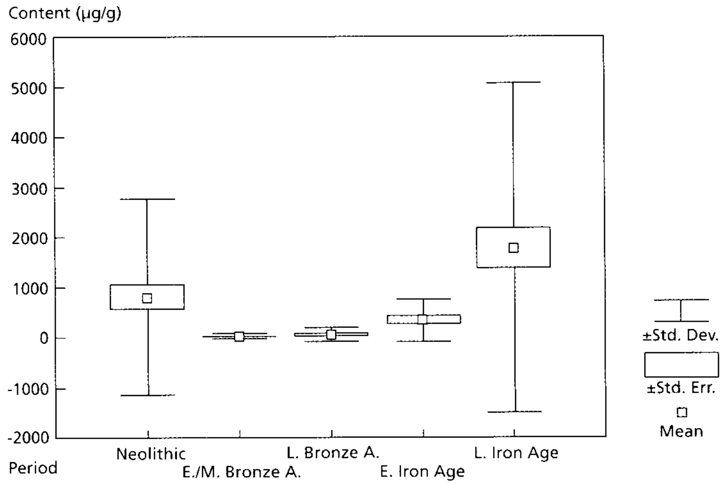

Figure 4. The distribution of lipid residue content (µg/g) in potsherds from various prehistoric periods in Sweden.

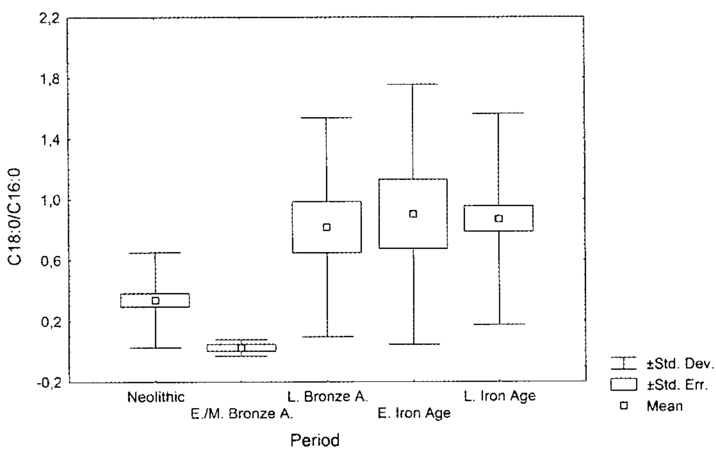

Figure 5. The distribution of C18:0/C16:0 fatty acid ratios in lipid residues from potsherds from various prehistoric periods in Sweden. A high ratio indicates large contributions from terrestrial animal.

ratio between the periods ($F(4, 147) = 7.32$, $p = 0.000$) mainly due to the very specialised pottery use in the Early/Middle Bronze Age. The relatively low ratio in the Neolithic period can probably be attributed to the higher degree of lipid residues from marine resources, and the even lower ratio in the Bronze Age period is in accordance with vegetable residues. The relatively low standard deviation in both this ratio and in lipid residue content confirms a very limited range of uses in the Bronze Age material. The total dataset seems to indicate a general trend of increase in the culinary exploitation of terrestrial animals over time.

The distributions of inferred pottery uses from the different periods are too complex (Fig. 6) to be discussed in detail in this short paper. The discussion will be limited to some reflections on the changes in the range of uses. To illustrate the changes in diversity of pottery use a diversity index (DI) was calculated using the formula $DI=1/\sqrt{(\Sigma[K_n/100]^2)}$ where K_n is the percentage of each pottery use in the distribution from each period (Fig. 6). A high DI indicates a high diversity in pottery use and a low DI that pottery was used for few purposes; a DI of 1 means that all pots were used for a single purpose. The calculated indices are presented in figure 7. The diversity is high in the Neolithic and lowest in the Early/Middle Bronze Age. There is a general increase towards the Late Iron Age, which also shows the highest level of diversity. The qualitative diversity index of distributions of pottery-use classifications is thus in accordance with the quantitative range widths of lipid residue content (Fig. 4).

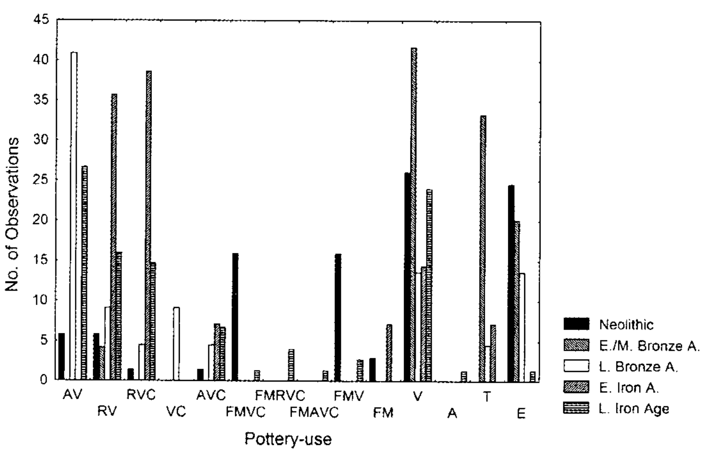

Figure 6. The distribution of pottery-use classifications (cf. Fig 2.) of lipid residues from the Neolithic (Uppland), Early/Middle Bronze Age (Uppland), Late Bronze Age (Scania), Early Iron Age (Scania) and Late Iron Age (Uppland) in Sweden.

Current and future research

The foregoing presentation has generated more questions than answers regarding prehistoric pottery use in Sweden, which also was my intent. The results discussed are based on quite small samples and there is still much to do, but some general conclusions can be drawn.

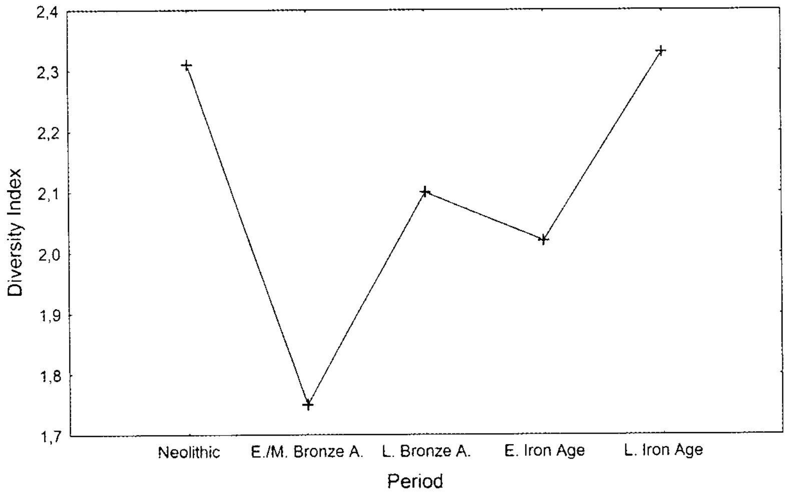

Figure 7. Diversity indices of pottery-use distributions (Fig. 6) from various prehistoric periods in Sweden. A high diversity index indicates a high diversity in pottery use and a low index that pottery was used for few purposes.

The pottery use in the Neolithic Pitted Ware culture in Uppland is characterised by a great diversity and complexity both between and within the various sites and through time. In contrast, the pottery use in the Early/Middle Bronze Age is much more limited and also more uniform between sites. The pottery use in Late Bronze Age Scania is more varied, but one trait in common with the Uppland Bronze Age material is the relatively low lipid residue content. In Scania there are significant changes in pottery use between the Late Bronze Age and Early Iron Age at one and the same site. The Late Iron Age material shows a great diversity in pottery use, and differences are found both within and between sites.

The most neglected period is the Early Iron Age and spatially there are vast uncharted territories. Some crucial questions that may be identified from the compilation presented in this paper are: whether and how the pottery use in the Pitted Ware culture differs from other Neolithic cultures; whether the difference between the Neolithic and Early/Middle Bronze Age is a local phenomenon in Uppland; whether the difference between the Late Bronze Age and Early Iron Age is a local phenomenon in Scania; and whether the difference between the Early Iron Age in Scania and the Late Iron Age in Uppland is a geographical or chronological difference.

Then there is the question of dairying. The earliest evidence for milk in the material presented above is from the Early Bronze Age. The Neolithic material presented here followed Highway E4 through central northern Uppland. In the Neolithic this was a coastal archipelago landscape, and to find the traces of early agriculture one would have to look for materials on higher ground.

Several of these issues are currently being approached. Research questions emanating from the observed patterns of Bronze Age pottery use are currently being tackled within the Spartan way of life project, financed by the Swedish Research Council. With a focus on ritual versus profane pottery use, a Master's thesis connected with this project has recently been published (Karlsson 2009).

Neolithic Funnel Beaker pottery, traditionally associated with the introduction of agriculture, is being analysed within the Cultaptation project, financed by the Sixth Framework Programme of the European Commission. In collaboration with Fredrik Hallgren, a small pilot investigation of vessels from a sacrificial fen at the site of Skogsmossen in Västmanland (Hallgren et al. 1997) has been performed, providing promising results. Worth mentioning is the identification of milk lipid residues (from the distribution of intact triacylglycerides) in this early material. Currently samples from a total of 197 Neolithic vessels have been analysed, from the Early to Late Neolithic, and further sampling is under way. The issue of the introduction of dairying will be thoroughly scrutinised through the LeChe project, financed by the EU and in collaboration with the Organic Geochemistry Unit of the School of Chemistry at the University of Bristol, UK. Another investigation of vessels from two spatially adjacent though chronologically separate sites in Södermanland, one with predominately Funnel Beaker pottery and the other with exclusively Pitted Ware pottery, shows significant differences in pottery use with respect to the different pottery styles (Ohlberger 2009).

I would like to characterise the underlying work as mutually open-minded collaborations between research and rescue archaeology. It is a collaboration that has generated new and systematic knowledge of the past. This new knowledge has in one way or another contributed to all the above-mentioned projects, all of which are in the forefront of their respective fields. That the exact sample selection was in the hands of each site-director had the advantage of providing answers to site-specific questions. In the future this could be supplemented by a more general sampling strategy in order to provide a representative material for answering questions of food culture practice that demand inter-site comparisons of pottery use.

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