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Social food here and hereafter: Multiproxy analysis of gender-specific food consumption in conversion period inhumation cemetery at Kukruse, NE-Estonia

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ABSTRACT

Current approaches in diet-related bioarchaeological research focus on establishing major developments in ancient societies, whilst small-scale and high-resolution studies of social constituents of past food consumption have gained far less attention. We conducted a multiproxy study of ancient diet in the 12th–13th century AD cemetery at Kukruse, NE-Estonia, in order to address the question of socially constrained food in the past. Two different food related archaeological sources – ceramic vessels and human bones – were investigated by applying organic residue (gas chromatography-mass spectrometry (GC-MS), bulk isotope ratio mass spectrometry (IRMS), gas chromatography-combustion-isotope ratio mass spectrometry (GC-C-IRMS)), and plant microfossil analysis for the first, and human bone stable isotope (IRMS) analysis for the latter. Results show that there was a gender and to some extent also age-specific food consumption by different community members at Kukruse: male (and some older female) diet was based on more aquatic and higher trophic level organisms, whilst younger females tend to feed on lower trophic level and potentially more herbivorous animals and their products. The paper emphasises the concept of past diet as a social phenomenon, the aspects of which can be best revealed with the help of multiproxy bioarchaeological analysis.

1. Introduction

Scientific analysis of ancient diet is a rapidly developing field of archaeological sciences. The subject has been tackled with various methods ranging from zooarchaeological and archaeobotanical analysis to bioarchaeological methods (cf e.g. Brown and Brown, 2011; Nigra et al., 2014). Archaeochemical approaches involve isotopic analysis of human and animal remains, but also organic (mostly lipid) residue studies of ancient food vessels. In lipid analysis the focus is usually on past food consumption and wider socio-economic narratives e.g. adoption of certain subsistence ways (Copley et al., 2005a-c; Craig et al., 2007, 2011; Cramp et al., 2014a,b; Heron et al., 2015; Isaksson and Hallgren, 2012), pottery production and corporate harvesting (Tache and Craig, 2015), increased sedentism (Oras et al., 2017), environmental changes (Lucquin et al., 2016), or ritual food consumption (Craig et al., 2015; Isaksson, 2000; Mukherjee et al., 2008). Micro-scale social questions, like social group specific diet, have been addressed with stable isotope studies of human remains to some extent (e.g. Barrett and Richards, 2004; Jørkov et al., 2010; Linderholm et al., 2008; Naumann et al., 2014; Pearson and Meskell, 2015; Somerville et al., 2015; White, 2005). Nevertheless, bone stable isotope analysis provides a broader, averaged generalisation of the diet of an individual, whilst, in comparison, organic residue analysis of single vessels affords a higher resolution data acquisition offering a snapshot of short-term cooking and food consumption, sometimes even allowing insights into single or subsequent event(s). Yet, these interim questions have so far stayed outside of the scope of the major trends of lipid residue analysis and combinations of the two approaches (human bone and ceramic analysis) for reconstructing past food consumption are scarce. As a result, several important elements of past human lives, especially the

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micro-scale social aspects of ancient food consumption, have gained undeservingly little attention.

This study aims to prove that combined analysis of lipid residues and plant microfossils from ceramic vessels, and stable isotopes from human remains can be a very fruitful and useful approach for not only solving the macro level questions of ancient food consumption and social development, but also for revealing short-term and micro regional social aspects of past communities. We have managed to identify gender specific diet traceable in both daily and ritual contexts. Our results demonstrate that ancient food consumption is indeed an environmental and economic but also a clearly social past phenomenon.

2. Material

Kukruse cemetery is a 12th–13th century AD burial ground located in NE-Estonia (Lõhmus et al., 2011). These centuries are also known as the time of Northern Crusades marking conversion period and war campaigns against the last pagan corners of Europe. Altogether 40 graves including men, women and children inhumations were discovered at Kukruse. Many of them (especially in the eastern part of the cemetery) were buried with rich funerary equipment ranging from weapons and tools to personal attires and jewellery, others were accompanied with personal items and dress accessories only (Fig. 1). Besides the ceramic vessels or pots (from here onwards these terms used as synonyms), food related finds were scarce. The faunal record included a limited number of teeth from different species such as cattle, sheep and pig (Maldre, 2010). The only exception was a deposition of an upper part of a horse skull, although this find most likely does not relate to the food processing either. Additionally, a complex of fish bones, identified as a pike (identified by PhD Lembi Lõugas, Tallinn University), was discovered at the left side of the male burial XLIII. The latter is the only osseous evidence associated with probable food consumption.

The ceramic pots (total of 14 vessels) were found across the studied part of the cemetery. Each burial in the wealthier eastern cluster was accompanied with a pot, but they were also found with adults in other parts of the cemetery. As for child-burials only two from the total of 14 children graves (up to 12 years of age) had pots in them. Vessels were mostly placed at the foot of the deceased, in two cases in the head area, in two children burials (one of them a double-burial) in the centre i.e. in stomach area in the single, and between the two bodies facing each other in the double burial. Pots were of different size and type: mostly wheel-thrown with line or wave decorated rim part (Fig. 2), but also one hand-moulded vessel was found. Their fabric and general outline varied to some extent and it can be presumed that we are dealing with both locally produced and imported vessels of NW-Russian and Ingermanland types (Tvauri, 2005). Mostly they were intact vessels, although shattered into sherds in time, but in two cases (burial XV and XL–XLI) only half of the pot, deliberately destructed by splitting lengthways, were buried with the dead. Some pots had clear signs of previous use – sooty stains and food-crusts –, whilst others did not bear any clear evidence of cooking. The list of pots analysed is provided in Table 1.

The preliminary anthropological analysis of the deceased (see Table 1) was conducted in the field and later detailed in laboratory conditions. Here we present the individuals with pots as grave goods and additional three individuals who did not have ceramic vessels with them, but were studied for stable isotope based diet reconstruction. The sex of the individuals was determined according to the morphological traits on the pelvis and cranium (Buikstra and Ubelaker, 1994: 16–20), and the maximum length of the long bones (Garmus and Jankauskas, 1993: 6–8) and tarsal bones (Garmus, 1996: 2). The age at death was determined according to the changes in pubic symphyseal face (Brooks and Suchey, 1990: 227–238; Todd, 1920, 1921), wearing of the teeth (Brothwell, 1981: 72), and age-caused changes on the limb joints (Ubelaker, 1989: 84–87). The age of subadults was determined by examining the development and eruption of the teeth (Ubelaker, 1989: 63), the epiphyseal fusion (Schaefer et al., 2009), and the length of the long bones (Allmäe, 1998: 183). For two individuals (XXXIII and XLIV) the sexing based on anthropological features was not conclusive. Although tentative, their likely sex is proposed on the basis of associated grave goods, also considering the gender-specific burial goods in the overall cemetery context as statistically established by Randoja (2016).

3. Methods

Samples of ceramic powder and food-crust from pots were analysed. Crust samples were removed using clean scalpels. Ceramic samples were obtained from internal and external surfaces of the vessels using hand drill, whereas drill bits for each sample were previously cleaned with dichloromethane (DCM) and the first layer of powder (ca 1 mm) was discarded to avoid surface contamination. Bulk isotope analysis of food-crusts was conducted with elemental analysis isotope ratio mass spectrometry (EA-IRMS). Food-crusts were also screened for plant microfossils, such as starch granules, plant tissues and phytolith, to establish the contribution of plants in food residues. Extracted lipids from pots and crust samples were analysed using gas chromatography - mass spectrometry (GC-MS) and gas chromatography - combustion - isotope ratio mass spectrometry (GC-C-IRMS). For sample preparation protocol the priority was first given to acid extraction (AE), because this method has proven to be more efficient in the case of low lipid concentrations (Correa-Ascencio and Evershed, 2014; Papakosta et al., 2015). However, if enough sample was available a slightly modified solvent extraction (SE) was applied as well, since in the case of good preservation this can provide more detailed data on specific biomarkers helping to further identify original food substances. The lifetime dietary reconstruction of individuals was estimated with human bone collagen stable isotope (carbon and nitrogen) analysis measured with EA-IRMS. The extraction protocols and analytical methods employed for samples from each pot and individual are listed in Table 1.

3.1. Plant microfossil analysis

Separated samples of outer surface crust (control) and the crust layer below that (expectedly less influenced by later environmental contamination) were analysed. Clean samples were prepared by sonicating the crust samples in ultrapure water, the content was then syphoned out and mounted on glass slides in a solution 50% ultrapure water and 50% glycerol for inspection under microscope at magnification up to 400 × .

3.2. Bulk isotope analysis of food-crusts

Bulk IRMS (isotope ratio mass spectrometry) analysis of food-crusts determining $\delta^{13}C$ and $\delta^{15}N$ relative to VPDB and AIR standards was conducted at the Department of Geology at the University of Tartu. Ca 1 mg food-crust sample was weighed into tin capsules. The samples were analysed with Thermo Scientific Delta V Plus + Thermo Finnigan Flash HT Plus using IAEA-N2 standards (the mean ± S.D. values within run 20.299 ± 0.1482), IAEA-CH3 (−24.611 ± 0.0244‰), IAEA-CH6 (−10.52 ± 0.0335‰).

3.3. GC-MS analysis

Lipid samples were separated from ca 1 g of ceramic powder or ca 20 mg of food-crust observing the protocol of acid-catalysed methylation with methanol (MeOH) followed by heating on a heating block at 70 °C for 4 h (Colonese et al., 2015; Craig et al., 2013; Heron et al., 2015). After heating lipids were extracted with n-hexane (3 × 2 ml) and dried under the gentle stream of nitrogen at 37.5 °C. Samples were dissolved in 100 μl of n-hexane with the addition of 10 μg of internal standard of $C_{36:0}$ (n-hexatriacontane).