3 The Neolithic in the Middle Morava Valley

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The Neolithic in the Middle Morava Valley:

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Наталија ЋОСИЋ и Славиша ПЕРИЋ

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Organic residue analysis and the use of pottery from the Neolithic settlements of Drenovac and Motel-Slatina (Middle Morava Valley, Serbia)[1]

Abstract:

The recognition of subsistence strategies, diet and culinary practices is one of the most important questions in the study of the development of Late Neolithic communities in the Middle Morava Valley. Pots serving as containers involved in many everyday activities related to preparing or the processing of food are an optimal and suitable source of information in this regard. However, the determination of vessel functions is usually a very problematic task, due to the preservation of the material, their fragmentation, scarcity of use-wear traces and heterogeneity of pot shape. Moreover, most of the Late Vinča pots seem to have fulfilled more than just one established purpose. Thus, the aim of this paper is to present the results of organic residue analysis (GC, GC-MS and GC-C-IRMS) to examine the use of pottery involved in the preparation, storage and consumption of different types of foodstuffs by the Late Vinča communities. Pottery from two Late Neolithic sites of Drenovac and Motel Slatina in the Middle Morava Valley, Central Serbia were chosen for the organic residue analysis. Vessels are shown to have been used to process a range of commodities including beeswax, ruminant dairy fats, ruminant adipose fats and non-ruminant adipose fats. A predominance of the processing of dairy products was observed at both sites, in vessels of varying sizes and types.

Key words: organic residue analysis, pottery, function, Late Neolithic, Vinča culture, Middle Morava Valley

Introduction

The Middle Morava Valley is a crucial region in the study of the process of the Neolithisation of Europe, particularly the Central Balkans. The appearance of Neolithic communities in this area and the trajectory of development might be tracked in various ways, however, studying the changes in the production, acquisition and processing of food offers a potential fruitful avenue of investigation. These phenomena have been addressed up to now mostly through zooarchaeology and archaeobotany. These studies have focused on a few specific questions such as the use of secondary products (the scale of production), and the role of wild as well as domesticated animals in the economy and diet of Late Neolithic communities. They have also addressed questions surrounding butchery practices, feasting, and the role of particular products and the communal consumption

1 This paper has resulted from the projects "Lactase persistence and the early Cultural History of Europe" (LeCHE) funded by an EU Marie Curie FP7 Framework Programme grant (FP7-ITN-215362-2) https://cordis.europa.eu/project/rcn/88283/factsheet/en) and "Archaeology in Serbia: cultural identity, integration factors, technological processes and the role of the Central Balkans in the development of European prehistory" (OI 177020) funded by the Ministry of Education, Science and Technological Development of the Republic of Serbia (project director Slaviša Perić, Institute of Archaeology, Belgrade).

in sociocultural transformations[2]. The focus on pottery so far has been dedicated to determining the primary, general function of the pots ('intended and actual function'), based mostly on the morphological and technological attributes of the vessels and through use-alteration analysis[3]. Ethnoarchaeological and experimental investigations provide further important support for interpretations of vessel use[4]. In their research, pottery specialists are faced with different challenges. For instance, the majority of the vessels in the Neolithic seem to have fulfilled more than one function[5], and use-wear traces are not always present to aid in interpretations. Specialisation in the usage of any particular type of pot (with regard to their morphology and technology) is rather rare and it is mostly related to specific functions, such as beekeeping, tar production or the processing of dairy products[6].

Organic residue analysis (ORA), which provides the analytical tools to directly determine the kind of foodstuffs processed in pottery, can make major contributions to the understanding of these issues in prehistory. The potential of the integration of traditional methods of pottery studies with chemical analyses has been demonstrated by work on other Neolithic ceramic assemblages from the Balkans. These studies offered hitherto unobtainable insight into the culinary practices over the course of the Neolithic, suggesting they were perhaps much more differentiated and elaborate than had previously been assumed[7].

Organic residue analysis applied to pottery in the Central Balkans has focused on Early Neolithic pottery assemblages in order to investigate the spread of early farming across Europe and to understand its regional diversity[8]. Pottery from eight Early Neolithic sites (Lepenski Vir, Velesnica, Vlasac, Aria Babi and Schela Cladovei[9] located in the Iron Gates of the Danube and Grivac, Divostin and Blagotin in Central Serbia[10]) were analysed to investigate if the first farmers in this area exploited dairy products. The results revealed that milk was used from the Early Neolithic. The results also showed regional variability in the use of ceramic vessels; while pottery from the sites in central Serbia was used mostly for processing dairy products and ruminant meat, in the Iron Gates region pottery was predominantly used for processing riverine resources[11]. These studies also showed that non-ruminant lipids were very rare among the lipid residues in pottery[12]. This aligns well with archaeozoological data, as domestic pigs are usually represented in a low abundance in the Early Neolithic faunal assemblages from the Central Balkans[13].

While Ethier et al. (2017) and Cramp et al. (2019) do not discuss the relationship between detected organic residues and vessel types, Spataro and colleagues focused more on pottery function and culinary practices, combining ORA with the investigation of pottery performance characteristics[14]. The latter results showed no correlation between organic residues and fabric, implying that no specific type of vessel was made for a specific use[15].

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2 Sherratt 1981, 1983, 1997; Chapman 1981, 1982; Tringham et al. 1985; Bokonyi 1988; Greenfield 1988, 1991, 2005, 2010;Tringham 1991; Russel 1998, 1999; Arnold, Greenfield 2004, 2005; Orton 2012; Perić et al. 2015; Stojanović, Obradović 2016.

3 e. g. Vuković 2011, 2012, 2013, 2015, 2019.

4 Popović 1956, 1957, 1959; Tomić 1966, 1983; Đorđević 2007; 2011, 2014, 2016; Vuković 2013.

5 Bajčev 2018; Vuković 2019.

6 Salque et al. 2013; Salque,Evershed 2015; Bartkowiak, Sobkowiak-Tabaka 2016.

7 Craig et al. 2003, 2005; Evershed et al. 2008; Šoberl et al. 2008; Roffet-Salque et al. 2015; Ethier et al. 2017; Cramp et al. 2019.

8 Ethier et al. 2017; Cramp et al. 2019.

9 Craig et al. 2005; Cramp et al. 2019; Spataro et al. 2019.

10 Ethier et al. 2017.

11 Ethier et al. 2017; Cramp et al. 2019.

12 Ethier et al. 2017.

13 Orton 2012, 26; Perić et al. 2015; Марковић и др. 2018. However, we need to bear in mind that archaeozoological samples for Early Neolithic in the Central Balkans are very small and statistics must be taken with caution.

14 Spataro et al. 2019.

15 Spataro et al. 2019.

Organic residue analysis of Late Neolithic Vinča pottery has not been conducted so far. Evidence for the use of milk and dairy products in Vinča communities has been suggested based on faunal kill-off patterns. The economy of Vinča settlements was usually based on mixed milk-meat exploitation of cattle and ovicaprines (for example at Petnica, Belovode, Opovo and Gomolava)[16]. Only at the site of Selevac are there indications of more milk oriented exploitation of caprines[17]. Domestic pigs were more important than in the Early Neolithic, being slightly dominant over ovicaprines in some Vinča settlements, i.e. Vinča–Belo Brdo[18].

Our research aims to use organic residue analysis to investigate Late Neolithic pottery use and to establish if the patterns identified in the Early Neolithic pottery assemblages could be recognised in the Late Neolithic, bearing in mind changes in animal exploitation strategies. Pottery from two Late Neolithic sites of Drenovac and Motel Slatina in the Middle Morava Valley, Central Serbia were chosen for organic residue analysis.

Archaeological context and sampling strategy

The choice of the sites of Drenovac (Slatina – Turska česma) and Motel Slatina was based on their particular importance in the recognition of Late Neolithic settlements in the Middle Morava Valley. The rich ceramic inventory, mostly well preserved, offered an opportunity to undertake detailed functional analysis.

The site of Slatina – Turska česma, better known as Drenovac, is situated on the right side of the Middle Morava Valley, around 9 km south of Paraćin. The first excavations were conducted by Savo Vetnić and the Jagodina Museum and the National Museum in Belgrade, uncovering the remains of both the early (Starčevo culture) and late (Vinča culture) horizons of the Neolithic settlements[19]. The fieldwork was reinitiated in 2004 under the Institute of Archaeology.[20] The new project has provided an abundance of new data concerning the Late Neolithic occupation of the site and yielded a rich collection of cultural material[21]. Unfortunately, the analysis of pottery assemblages has not yet been published. The preliminary analysis of faunal remains from Drenovac indicates that the main domesticates at the site were cattle, caprines (goats and sheep) and pigs[22]. Based on dental analysis, cattle were at least to some degree exploited for milk, while age-at-death analyses for caprines show a possible change in their exploitation towards more intensive milk use in the later phase.[23]

The second site, Motel–Slatina, is situated on the eastern periphery of Paraćin, on the right bank of the Crnica River, a right Morava tributary. The site was discovered during the process of construction of the Belgrade–Niš highway, in 1961/62[24], although only a small-scale rescue excavations were undertaken. The second excavations started in the early 1980s and were continued in 1985, 1986, 1997 and 2000–2002. Since 1997, excavations have been conducted jointly by the Institute of Archaeology and the Paraćin Museum[25]. Unfortunately, the analysis of pottery assemblages has also not yet been published. The results of the archaeozoological analyses[26] indicate

16 Greenfield 1991; Arnold, Greenfield 2005; Vigne and Helmer 2007; Orton 2012; Bulatović 2018.
17 Orton 2012.
18 Orton 2012, 26; Bulatović 2018, 88.
19 Vetnić 1974, 155.
20 The excavations are still ongoing as a part of the project "Permanent Archaeological Workshop – Middle Morava Valley in the Neolithization of South-East Europe" – funded by the Ministry of Culture and Information of the Republic of Serbia (project director Slaviša Perić).
21 Perić 2016, 2017.
22 Perić et al. 2015; Obradović, Stojanović 2019.
23 Obradović, Stojanović 2019; Stojanović in prep.
24 Vetnić 1974, 160 footnote 124.
25 Excavations in 2002 were conducted as part of the above mentioned project "Permanent Archaeological Workshop – Middle Morava Valley in the Neolithization of South-East Europe"; Перић 2004.
26 The small analysed faunal sample from the site of Motel Slatina (NISP=249) comes from the Vinča cultural layer in Trench Gasovod II, excavated in 1997 and 2000.

Sample number	Site	Year of excavation	Trench	Square	Layer	Description	Context	Relative chronology
SL1	Motel Slatina	2001	ZIPP III			Layer „b”	Cultural layer	Vinča-Pločnik
SL9	Motel Slatina	2001	ZIPP III		12	Layer „c”	Cultural layer	Vinča-Tordoš
SL17	Motel Slatina	2002	ZIPP III			Northern extension, layer „d”	Cultural layer	Vinča-Tordoš
SL20	Motel Slatina	2002	ZIPP III			Northern extension, layer „d”	Cultural layer	Vinča-Tordoš
SL21	Motel Slatina	2002	ZIPP III			Northern extension, layer „d”, surface with burned soil	Cultural layer	Vinča-Tordoš
SL22	Motel Slatina	2002	ZIPP III			Northern extension, surface with burned soil	Cultural layer	Vinča-Tordoš
SL23	Motel Slatina	2002	ZIPP III			Northern extension, surface with burned soil	Cultural layer	Vinča-Tordoš
SL30	Motel Slatina	2002	ZIPP III			Northern extension, layer „g”	Cultural layer	Vinča-Tordoš
SL35	Motel Slatina	2002	ZIPP III			Area P4, eastern half	Pit	Vinča-Tordoš
SL42	Motel Slatina	1985–1986	Sector I, trench 2			House with the altar	House with the altar	?
DRm2	Drenovac	2004	XV			Removal of destruction layer of House 1, south-eastern part	Destruction layer house 1/XV	Vinča-Pločnik
DRm3	Drenovac	2004	XV		14	Area P5	Cultural layer, next to house 1/XV	Vinča-Pločnik
DRm4	Drenovac	2004	XV		13	Area P5	Cultural layer, next to house 1/XV	Vinča-Pločnik
DRm5	Drenovac	2004	XV	1	15–17		Cultural layer	Vinča-Pločnik
DRm6	Drenovac	2004	XV	1	10		Cultural layer above destruction layer of house 1/XV	Vinča-Pločnik
DRm13	Drenovac	2004	XV		5	Northern half	Cultural layer	Vinča-Pločnik
DRm14	Drenovac	2004	XV		5	Northern half	Cultural layer	Vinča-Pločnik
DRm18	Drenovac	2005	XV	3	20		Cultural layer	Vinča-Pločnik
DRm22	Drenovac	2005	XV	1	30		Cultural layer	Vinča-Tordoš
DRm24	Drenovac	2005	XV	1	33		Cultural layer	Vinča-Tordoš
DRm25	Drenovac	2005	XV	1	33		Cultural layer	Vinča-Tordoš
DRm28	Drenovac	2005	XV	1	36	Area ACD	Cultural layer (next to the destruction layer of the house)	Vinča-Tordoš
DRm34	Drenovac	2005	XV	3	41		Cultural layer	Vinča-Tordoš
DR3	Drenovac	2010	XVII	Unit 26	1		Concentration of pottery sherds next to house 1/XVII	Vinča-Pločnik
DR14	Drenovac	2010	XVII	Unit 26	1		Concentration of pottery sherds next to house 1/XVII	Vinča-Pločnik

Table 1 – Details of contexts of samples with identified organic residues from Drenovac and Motel–Slatina

Sherd Number	The form of vessel	Fragment of pot	Lipid Concentration (µg g-1)	δ13C16:0 ±0.3 (‰)	δ13C18:0 ±0.3 (‰)	Predominant commodity
DR3	uncertain	base	5.05	-26.282	-24.916	NRA
DR-14	amphora	rim	64.27	-27.15	-30.25	Mixture RA/RD
DRm-2	bowl	base	37.47	-28.16	-28.19	Mixture NRA/RA
DRm-3	bowl	rim	119.03	-27.89	-30.56	Mixture RA/RD
DRm-4	bowl	complete profile	72.26	-27.20	-30.09	Mixture RA/RD
DRm-5	bowl	rim	26.93	-27.20	-32.10	RD
DRm-6	amphora	belly	24.49	-27.36	-31.46	RD
DRm13	bowl	complete profile	136.34	-29.135	-32.279	Mixture RA/RD
DRm-14	bowl	rim	28.99	-27.36	-32.62	RD
DRm-18	amphora	neck	17.19	-27.15	-30.72	RD
DRm 22	bowl?	belly	24.14	-27.047	-33.376	RD/Beeswax
DRm24	bowl?	belly	91.63	-25.472	-27.067	RA/Beeswax
DRm-25	bowl	rim	27.98	-27.95	-31.67	RD
DRm-28	amphora	rim	38.00	-28.27	-31.14	Mixture RA/RD
DRm 34	bowl or pot	base	12.33	-26.543	-32.914	RD
SL-1	bowl	rim	15.49	-27.74	-31.30	RD
SL-9	jar	rim	8.65	-30.60	-34.79	RD
SL-17	jar	rim	11.69	-30.55	-35.05	RD
SL20	small bowl	bowl	37.97	n/a	n/a	RD
SL-21	bowl	rim	4.42	-29.33	-31.09	RA
SL-22	bowl/small amphora	belly	28.96	-28.64	-34.58	RD
SL-23	pot/bowl	belly	83.26	-27.68	-32.20	RD
SL-30	pot	rim	32.16	-27.84	-31.57	RD
SL35	sieve	belly	16.99	-26.356	-32.341	RD
SL42	amphora	rim	38.65	-25.974	-29.213	Mixture RA/RD

Table 2 – The results of the ORA of potsherds from Motel-Slatina (SL) and Drenovac (DR and DRm)

that the economy of this settlement was mostly based on cattle, but other domestic (pig [28.49%], sheep/goat [25.58%] and wild animals (deer, wild boar, auroch, and roe deer) were also documented[27].

Pottery sherds were selected for analysis from trenches XV and XVII (the site of Drenovac) and House with the altar, Feature 5 and trench ZIPP III (the site of Motel Slatina).

The sherds from Drenovac and Motel Slatinain in most cases, were obtained from cultural layers outside the features (Tab. 1). Some of them were found in pits (SL35), in the vicinity of the house (DR14) or in the house destruction layer (for example DRm2), but since the houses are burned, and these sherds lack any traces of secondary burning, we cannot say with any certainty if they were an inventory of houses, or redeposited. After the analysis of other materials from these contexts we will be able to say more about the nature of these deposits.

A total of 99 pottery sherds were analysed using organic residue analysis (refered to as ORA in the further text) – 49 from Drenovac and 50 from Motel–Slatina. Sherds were selected both from the Vinča–Tordoš, and Vinča–Pločnik phase of the settlements (Tab. 1). The sampling of potsherds for ORA was directed toward distinctive, relatively large fragments from well-defined contexts. The sherds were taken from previously diagnosed and well-studied pots based on their morphological and technological attributes. The majority of the analysed potsherds belong to

27 Cvetković 2004.

Figure 1. The studied ceramics from Drenovac, grouped into five categories: amphoras (big and medium in the size), bowls (restricted shouldered bowls, unrestricted shouldered bowls, unrestricted conical bowls, restricted bowls with rounded walls), simple pots with conical or rounded wall, jars and small "amphorae"

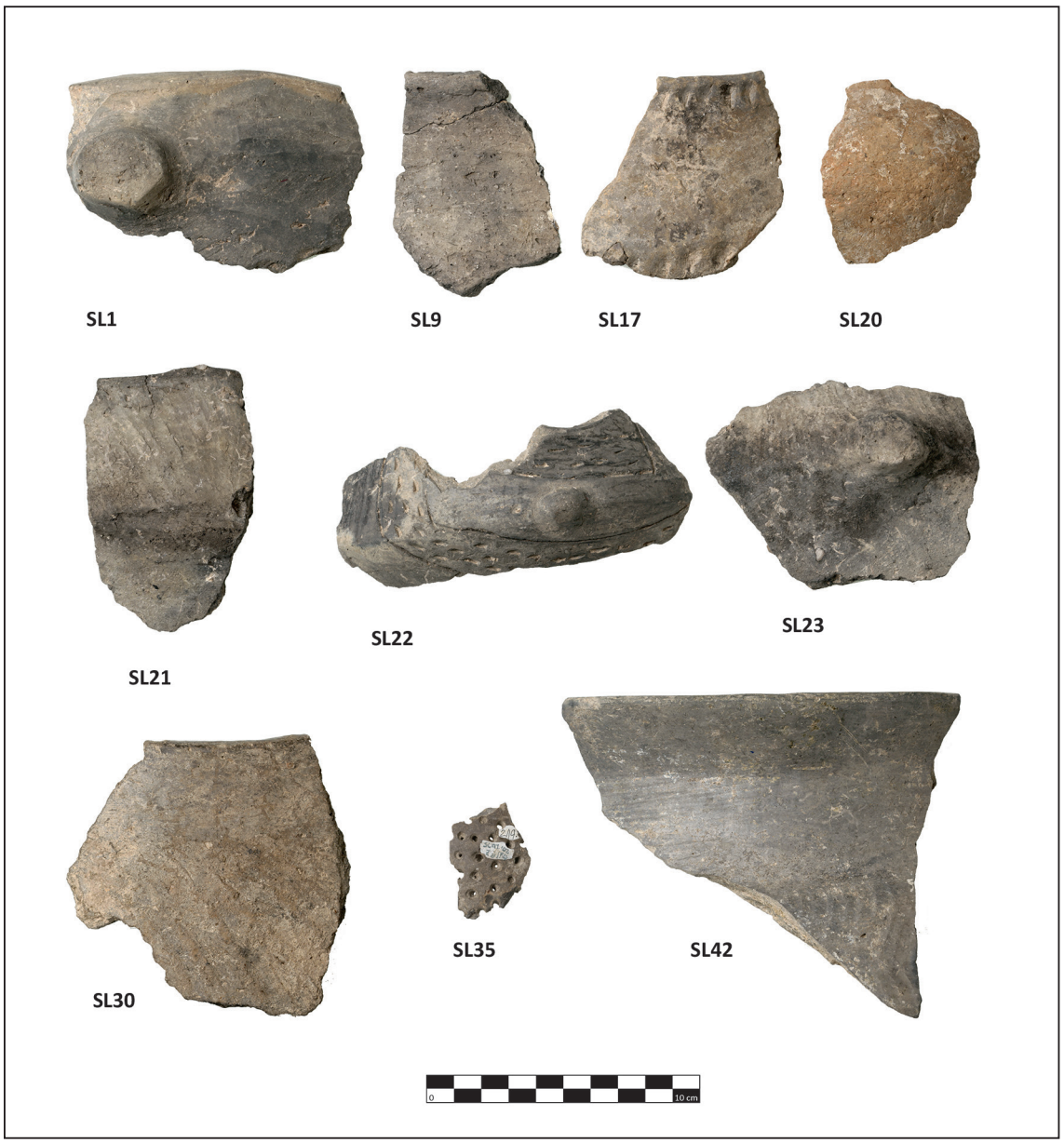

Figure 2. The studied ceramics from Motel–Slatina

fragments with a complete profile or rim (ca. 65% of all chosen sherds), but some body or base sherds were also included (Tab. 2). Cooking vessels were primarily selected though other pot categories have also been sampled. The selection of potsherds included fragments with various surface treatments and the presence of use-wear traces. The studied ceramics can be broadly grouped into five categories and these are: amphorae (big and medium in size), bowls (restricted shouldered bowls, unrestricted shouldered bowls, unrestricted conical bowls, restricted bowls with rounded walls), simple pots with conical or rounded walls, small restricted vessels, small "amphorae" and strainers (Fig. 1, 2). Strainers were selected specifically to test the hypothesis of their use for cheese production[28].

28 Sherratt 1983; Bogucki1984, 1986; Craig et al. 1993.

Methods

Organic residue analysis utilises a suite of techniques, namely: gas chromatography (GC), GC-mass spectrometry (GC-MS) and GC-combustion-isotope ratio MS (GC-C-IRMS), in order to extract, identify and characterise absorbed lipids from potsherds. This allows the quantification and identification of a range of compounds as oils, resins, bitumens, waxes and animal fats and also establishes their origin (e.g. it discerns between ruminant dairy lipids (RD), ruminant adipose fats (RA) and non-ruminant adipose fats (NRA). Hence, in combination with other archaeological methods of functional analysis[29], ORA can be very useful for the recognition of the usage of pots, allowing the investigation of specialised functions, e.g. the processing of dairy products[30].

The standard analytical protocol was followed[31]. Briefly, a 2 g portion of the sherd was mechanically cleaned using a modelling drill to remove any exogenous contamination. The cleaned sherd was then crushed and transferred to a clean glass vial and a known amount of internal standard (20 mg of *n*-tetratriacontane) was added. Lipids were then extracted using 2 x 10 mL chloroform/methanol (2:1 *v/v*) with sonication. Prior to GC analyses, an aliquot of the total lipid extract was derivatised using N,O-bis (trimethylsilyl) trifluoroacetamide (BSTFA) containing 1% trimethylchlorosilane (TMCS; Sigma Aldrich) and evaporated under a stream of nitrogen. The total lipid extract (TLE) was then dissolved in *n*-hexane and analysed by HTGC. An aliquot of TLE containing >5µg g^{-1} of lipids were saponified using methanolic sodium hydroxide (5% *v/v*) prior to methylation using BF_3-methanol (14% *w/v*; Sigma-Aldrich). The resulting fatty acid methyl esters (FAMES) were analysed using GC, GC-MS and GC-C-IRMS[32]. For isotopic analyses, samples were run in duplicate and an average taken. The $\delta^{13}C$ values are the ratios $^{13}C/^{12}C$ and expressed relative to the Vienna Pee Dee Belemnite, calibrated against a CO_2 reference gas of known isotopic composition. Instrument error was ±0.3‰.

Results

Twenty-five sherds contained an appreciable concentration of lipids (>5 µg g^{-1}). Differences in lipid preservation were observed between the two sites. At Drenovac, lipids were detected in 31% of the analysed potsherds (n=15), whereas at Slatina, fewer sherds (20%, n=10) contained absorbed lipid residues (Tab. 2). The mean lipid concentration from the sherds yielding interpretable lipid profiles from Drenovac was 45 µg g^{-1}, with a maximum lipid concentration of 136 µg g^{-1}, while the average lipid concentration at Motel Slatina was 27 µg g^{-1}, with a maximum lipid concentration 83 µg g^{-1}. Lipid profiles from both sites reveal the presence of free fatty acids, specifically palmitic (C_{16}) and stearic (C_{18}) acids, typical of degraded animal fats (Fig. 3a). Compound-specific stable carbon isotope analyses for the free fatty acids *n*-$C_{16:0}$ and *n*-$C_{18:0}$ were conducted to identify the origin of the animal fats recovered (Fig. 3b).

The $\delta^{13}C$ values from Drenovac show relatively enriched $\delta^{13}C_{16:0}$ and $\delta^{13}C_{18:0}$ values and plot offset from the confidence ellipses along the mixing curve suggesting a C_4 or environmental influence (Fig. 3b). At Slatina this is also apparent; however, some of the $\delta^{13}C$ values sit within the confidence ellipses suggesting C_3 and C_4/environmental influence at the site.

The $\Delta^{13}C$ values show that ruminant dairy fats (RD) are the predominant fats types identified at both Drenovac (n=6) and Motel–Slatina (n=8; Fig. 3a, b, Tab. 2). Ruminant dairy fats were identified in several different kinds of vessels: small restricted vessels (SL9, SL17), amphorae (DRm6, DRm18, SL22) and various types of bowls (DRm5, DRm14, DRm25, SL1, SL20). Judging by their shapes and sizes, they could have been used in different food related practices

29 Analysis of performance characteristics in the investigation of the intended function of pottery (Skibo, Schiffer 2008, 18ff; Skibo 2013, 27ff; Vuković 2019) and analysis of use-wear in the research of the actual use of vessels (Skibo 1992, 2013).

30 Evershed 1993, 2008; Dudd, Evershed 1998; Dudd et al. 1999; Copley et al. 2005a–c.

31 See Copley 2005a–c for more details.

32 Evershed 1993; Copley et al. 2003.

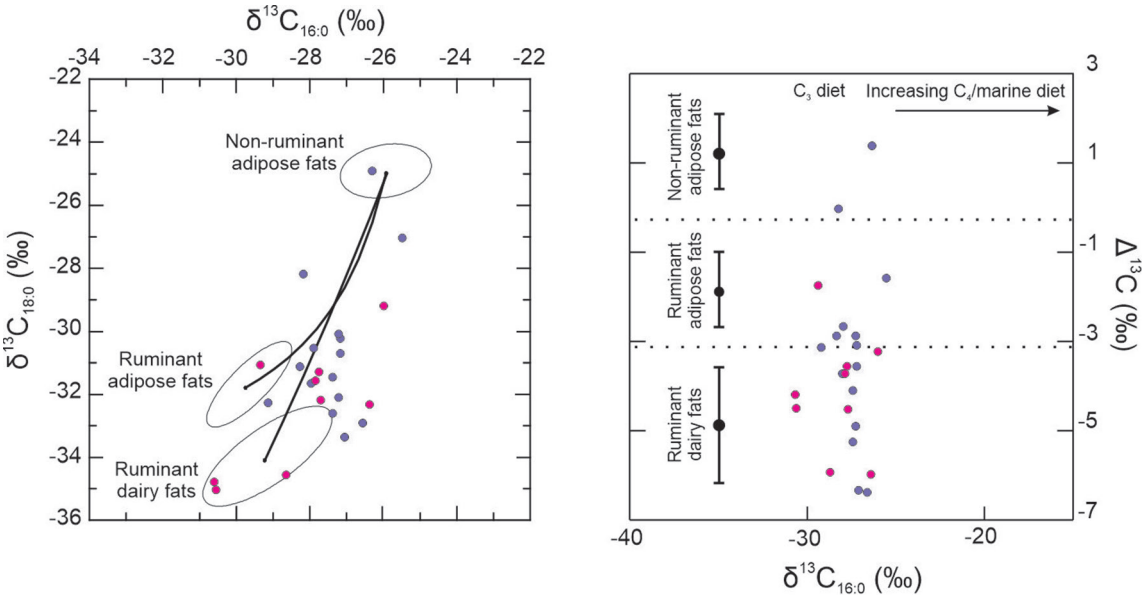

Figure 3. a) $\delta^{13}C$ values for the n-$C_{16:0}$ and n-$C_{18:0}$ fatty acids prepared from lipid extracts from Drenovac (purple) and Slatina (pink) b) The difference in the $\delta^{13}C$ values of the n-$C_{18:0}$ and n-$C_{16:0}$ fatty acids ($\delta^{13}C = \delta^{13}C_{18:0} - \delta^{13}C_{16:0}$) obtained for the same archaeological fats. The values of reference fats are represented by confidence ellipses (±1 σ) for animals raised on a strict C_3 diet (Copley et al., 2003). Analytical precision is ±0.3 ‰.

including storage, preparation, serving and consumption of dairy products. Ruminant dairy fats were also identified in one of the two analysed fragments of strainers (SL35). This kind of perforated vessel is well documented among the whole Vinča culture, but is often found in small numbers on Vinča sites in Serbia. Usually, perforated vessels are only briefly mentioned or illustrated in site reports[33], and little consideration has been given to their function[34]. Similar strainers are known from other Neolithic cultures from Europe and the Near East and they have been linked to cheese production, as other ORAs have demonstrated[35]. These vessels are comparable in form to modern and ethnographically known cheese strainers that are used to separate milk curds from the lactose-containing whey[36]. It must be mentioned that the production of cheese might have played an important role in the prehistoric subsistence strategies of these people, supplying nutritious food without slaughtering livestock and the long-term preservation of milk products[37]. The presence of a strainer sherd with absorbed lipids with a ruminant dairy fat origin supports the hypothesis that in the Vinča culture such vessels were used in cheese making.

One open bowl from Slatina (SL21) has a $\Delta^{13}C$ value that indicate the processing of ruminant adipose fats. The $\Delta^{13}C$ values also show that residues also plot within the ranges expected for mixtures of ruminant adipose fats (RA) and ruminant dairy fats (RD; Drenovac, n=5; Slatina, n=1).

33 For example Vasić 1936, 13, 26, 60, 92; Спасић 2011, 127, T. XXIII, 132, 140, сл. 7; Perić et al. 2016, T. IV/6, 269.
34 Васић 1936, 13.
35 Bogucki 1984, 1986; Evershed et al. 2008; Salque et al. 2013.
36 Barker1981; Bogucki 1984, 1986; Takaoglu 2006, 23; Evershed et al. 2008; Salque et al. 2013; Bartkowiak, Sobkowiak-Tabaka 2016.
37 Sherrat 1981, 1983.

At both sites, mixtures of RA and RD are identified in amphorae (DRm14, DRm28, SL42), while in Drenovac the same mixture is also present in bowls (DRm3, DRm4. DRm13). The presence of both RD and RA fats could indicate the mixing of animal products in preparation of the same meal or re-use of the vessels for different purposes. Alternatively, the fat could have been used as a waterproofing agent applied on the inner surface of the pot, or the same effect could have been achieved by a boiling of milk.

Only one vessel from Drenovac (DR3) has a $\Delta^{13}C$ value consistent with the processing of non-ruminant adipose products. The sherd is a fragment of a base and the shape of the vessel is unknown. The $\Delta^{13}C$ values also show that residues plot within the ranges expected for mixtures of non-ruminant adipose (NRA) and ruminant adipose fats (RA) (Drenovac, n=1; DRm2). This mixture is noted in an open conical bowl from Drenovac. Based on the results of ORA we cannot differentiate if ruminant and non-ruminant meat or fat were mixed in one meal, or if they represent the traces of different uses of the same vessel (Fig. 1).

The presence of beeswax identified from characteristic distributions of *n*-alkanes and long-chain hydroxy wax esters, was detected in two sherds from Drenovac (DRm22 and DRm24). This suggests either bee products were processed within the vessels, or beeswax was used as a post-firing treatment or it is a by-product from honey use[38]. Stearic acid was also identified in these samples, indicating the presence of animal fat[39], in one case ruminant diary (DRm22) and in the other ruminant adipose fat (DRm24). Again, based on the ORA, we cannot conclude if these ingredients were mixed together or were used separately on different occasions and for different reasons.

Conclusions

The examinations of the Late Neolithic ceramic assemblages discussed above have enabled a considerable broadening of the knowledge of food habits among the communities of Vinča culture. The organic residues provide direct evidence of the use of different foodstuffs, including dairy, ruminant and non-ruminant adipose and bee products. In particular, the presence of the beeswax suggests the processing of bee products either as a result of bee keeping or honey gathering among the Vinča community, which have not been suggested previously. However, the function of the vessels containing beeswax could not be directly determined. Additionally, the analyses have shown that dairy products were available as early as the Vinča Tordoš phase (around 5300–5200 BC). The high frequency of ruminant dairy fats suggest that dairy products fulfilled a significant role in the diet of these populations. The results indicate a lack of any clear pattern concerning the usage of vessels among the Vinča communities. The only regularity in the use of particular types of pot was observed among the group of amphorae and jars. These vessels seem to be related to the processing and storage of dairy products or a mixture of dairy products and carcass products.

A noted emphasis on ruminant adipose products and an almost complete absence of non-ruminant lipids is similar to results obtained for the Early Neolithic subsistence practices in the area. Potential contributors of ruminant products include domestic – cattle, sheep and goat, and wild animals (aurochs, red and roe deer), all of which were well-represented in the Late Neolithic assemblages. Non-ruminant adipose fats can reflect the exploitation of wild or domestic pigs. While local archaeozoological assemblages are dominated by domesticated cattle, pig is more represented than in the Early Neolithic, sometimes outnumbering sheep/goat, as observed at the site of Motel–Slatina. For this reason, we would expect more non-ruminant lipids in Late Neolithic pottery, however, at Motel–Slatina in particular, non-ruminant lipids were not detected. This low representation of non-ruminant lipids in pottery could be explained by different preparation practices of pig meat that did not involve pottery, such as roasting. This should be further considered

38 Evershed et al. 1997; Regert et al. 2001; Roffet-Salque et al. 2015.
39 Charters et al. 1995.

by investigation of butchering traces on the bones of different animals. However, the number of studied sherds is still insufficient to build any final conclusions.

In summary, this research has enabled additional information about the kind of foodstuffs processed in the Late Neolithic pottery to be revealed. Moving forward, this information will be compared with vessel performance characteristics and use-wear, in order to further investigate the intended and actual function of vessels and will provide a more comprehensive understanding of the everyday activities and economy of Neolithic people.

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Резиме

Анализе органских остатака и употреба грнчарије из неолитских насеља Дреновац и Мотел Слатина (Средње Поморавље, Србија)

Спроведена анализа органских остатака са каснонеолитске грнчарије са налазишта Дреновац и Мотел Слатина омогућила је ширење знања о исхрани заједница винчанске културе. Овом анализом идентификовали смо употребу различитих намирница, као што су млечни производи, масти преживара и не-преживара и пчелињи восак. Поред тога, анализа је показала да су млечни производи коришћени још у фази Винча–Тордош. Висока учесталост млечних масти у односу на остале врсте масноћа указује на то да су млечни производи вероватно играли значајну улогу у исхрани ове популације. Присуство млечних масти на фрагменту цедиљке са налазишта Мотел–Слатина, иде у прилог претходним претпоставкама о коришћењу оваквих посуда у производњи сира. Са друге стране, мала заступљеност масти не-преживара, можда може да нам укаже на другачији вид припремања меса домаћих свиња, који није укључивао грнчарију.

У анализираном узорку није било могуће препознати јасан образац између облика посуде и идентификованих липида. Једина правилност у коришћењу одређене врсте посуда уочена је међу амфорама и мањим посудама затворене форме. Чини се да су ове посуде повезане са прерадом, складиштењем или сервирањем млечних производа или мешавине млечних производа и животињских масти.

Иако смо помоћу овог истраживања добили додатне информације о врсти намирница које су коришћене у каснонеолитској грнчарији, још увек нам недостају информације о праксама припреме хране. Због тога је наш будући циљ да податке добијене анализом органских остатака упоредимо са перформансама посуда и траговима употребе, како бисмо даље истражили намерену и стварну функцију грнчарије. Ова врста сложене студије дала би нам свеобухватније разумевање свакодневних активности и економије неолитских заједница.

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