

Recognising archaeological food remains: archaeobotanical case studies from Bulgaria

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ABSTRACT

The paper discusses possible evidence for cereal food from seven Bulgarian archaeological sites spanning the Early Neolithic to the Early Iron Age (6th millennium BC – 1st millennium BC). It aims to increase the awareness of excavators towards such finds and to present the methods for collecting and extracting such remains from archaeological layers and their laboratory analysis. The studied remains are mainly cereal fragments, agglomerations of fragments or amorphous/ porous masses with or without visible plant tissues. They were directly collected from vessel contents or derived by means of flotation from bulk samples taken from floor layers close to fireplaces/ cooking installations. The microscopic structure of the food remains is observed and described at plant tissue level under low magnification binocular, microscope with reflected light and Scanning Electron Microscope (SEM). These optical examinations were applied in order to detect alterations of the microstructure of the possible food remains and hence to trace the possible ways of food preparation. All the cereal food remains from the Neolithic/Chalcolithic period represent coarsely ground cereals, while the later ones (Late Bronze Age and Early Iron Age) have characteristics of finely ground cereal products and may suggest the introduction of new cooking/ baking techniques as well as shifts in food processing practices. Based on their field experience and research results the authors strongly recommend careful sampling and documentation of any charred crusts recognisable as such in vessel contents, and deposits around installations like ovens and fireplaces, which could be related to daily food preparation or ritual offerings. Such systematic study of archaeological food remains will facilitate obtaining reliable information about food preparation and consumption in the past.

KEYWORDS

Cereal food remains, plant macroremains, Scanning Electron Microscopy (SEM), Southeast Europe, Early Neolithic – Early Iron Age

Introduction

The cultivated crops and the meals produced of them are tightly connected with the environmental characteristics of a region. However, the food and its ingredients are also a

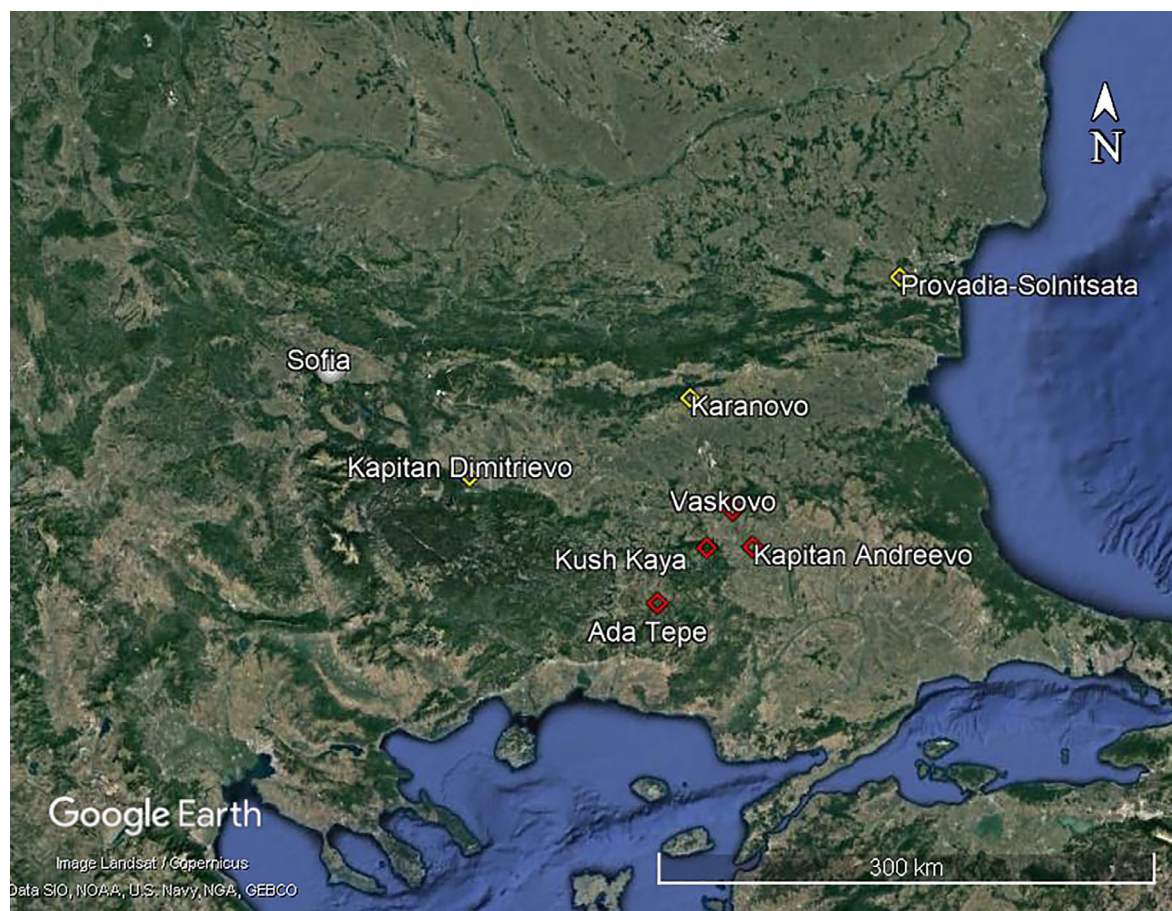


Fig. 1. Map of the study area: yellow rhomb – Neolithic/ Chalcolithic sites; red rhomb – Late Bronze and Early Iron Age sites

Обр. 1. Карта на изследвания район: жълт ромб – неолитни/ халколитни обекти; червен ромб – обекти от късната бронзова и ранната желязна епоха

reflection of the cultural and economic attributes and the everyday life of the society. Cereals which have been staple crops since the beginning of farming and the food produced of them provided one of the bases for surplus and demographic increase of ancient populations, a precondition for further technological and societal developments. The current paper offers a diachronic review of cereal food finds from several Bulgarian sites spanning the Early Neolithic through to the Early Iron Age (6th millennium BC – 9th century BC; for more precise dating see Table 1). The material presented here has already been briefly discussed in a recent article presenting an overview of the types of prehistoric cereal food remains encountered in Greek and Bulgarian sites (Valamoti et al. 2019). Here, the study moves forward by examining these finds in a more thorough way, putting emphasis on the contextual information by considering the specific archaeological and archaeobotanical information for each find. In this way, a better understanding of the processes that generated these finds, as well as the intended uses can be inferred. Moreover, a broader chronological contextualisation of the finds can be achieved. Possible preparation practices and ingredients are discussed aiming to reveal different ways of transformation of plants into food. In addition, the paper reviews the criteria for identification and determination of archaeological food remains and aims to increase the awareness of the archaeological research for this category of finds.

Food category	Appearance	Possible ingredients	Site	Period	Absolute dates
Loose cereal fragments	coarsely ground cereal grains	einkorn, emmer, barley	Kapitan Dimitriev	Early Neolithic II	5650–5450 BC
Agglomerations of cereal fragments fused together	coarsely ground cereal grains separate and lumped together	einkorn, emmer, barley	Karanovo	Early Chalcolithic	4900–4700 BC
Agglomerations of cereal fragments fused together	coarsely ground cereal grains separate and lumped together	barley; plants different from cereals	Provadia-Solnitsata	Middle Chalcolithic	4700–4600 BC
Agglomerations of cereal fragments in an amorphous matrix	porous texture with whole and fragmented grains	millet, barley, linseed	Kush Kaya	Late Bronze Age	1350–1275 BC
Amorphous masses with no visible cereal fragments	amorphous homogenous texture	barley, wheat	Ada tepe	Early Iron Age	1100–850 BC
Amorphous masses with no visible cereal fragments	amorphous homogenous texture	barley	Kapitan Andreevo	Early Iron Age	1000–850 BC
Amorphous masses with no visible cereal fragments	amorphous homogenous texture	einkorn, millet	Vaskovo	Early Iron Age	1000–850 BC

Table 1. Summary of the cereal based food remains, their possible ingredients, and dating of the archaeological context

Таблица 1. Обобщение на останките от храни от житни култури, техните възможни съставки и хронологическа принадлежност на археологическите структури

Research on ancient cereal food remains has been going on for several decades (Hansson, Isaksson 1994; Valamoti 2002; Heiss 2008; Heiss et al. 2015, 2017, 2019; González Carretero et al. 2017; Valamoti et al. 2019). Studies of such remains from Southeast Europe (Marinova 2006b; Valamoti 2002, 2011; Valamoti et al. 2008; Popova 2016; Popov et al. 2018) made preliminary interpretation describing them as bulgur and/or trahanas, bread and/or porridge (for detailed terminologies on traditional cereal based food preparations see Cappers et al 2016; Cappers 2018), sometimes backed by experimental investigations (Valamoti 2002, Valamoti et al. 2008). Later Valamoti (2018) suggested an alternative interpretation of various charred food remains as related to the process of preparing cereal based alcoholic products. In a recent paper an attempt to describe the potential food categories was made (Valamoti et al. 2019) based on the morphological criteria combining macroscopic appearance and microscopic features of the surface and the internal structure. In this article, the proposed food categories are summarised as: a) loose cereal fragments, b) agglomerations of cereal fragments, c) agglomerations of fragments in an amorphous matrix, d) amorphous masses with ‘bubbles’. The broad terms used for these food remains are “cereal products” and “cereal (based) food remains” indicating that some kind of processing of the cereals

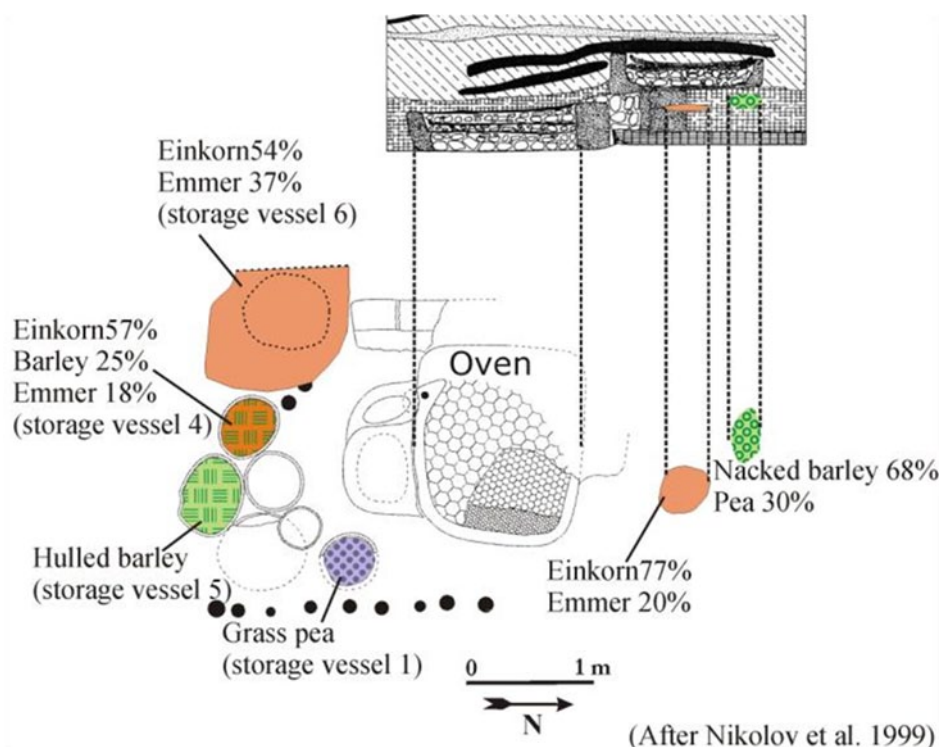


Fig. 2. Archaeological context of the food remains found at Kapitan Dimitriev. The studied material comes from storage vessel № 4 (after Marinova 2006b, 48, fig. 6.8 and Nikolov 1999, 13, fig. 3; 17, fig. 6)

Обр. 2. Археологически контекст на хранителните останки, открити в Капитан Димитриево.

Изследваният материал е намерен в съд-зърнохранилище № 4 (по Marinova 2006b, 48, fig. 6.8 и Nikolov 1999, 13, fig. 3; 17, fig. 6)

has been performed before charring (Valamoti et al. 2019). Those terms are applied also here, in order to avoid an over interpretation by using terms connected with a particular type of processing. It is important to mention that in some or even in most of the cases, it is difficult to define the food representing category as the remains could well represent more than one. In order to apply the classification of cereal food remains proposed by Valamoti et al. (2019) the pre-depositional processing and taphonomic factors have also been taken into consideration and are discussed below.

Materials and methods

The material presented here comprises charred cereal food remains coming from seven Bulgarian sites: Kapitan Dimitriev, Karanovo, Provadia–Solnitsata, Kush Kaya, Kapitan Andreevo, Ada Tepe and Vaskovo, spanning the Neolithic through to the Iron Age (fig. 1).

The sites and materials under study

The site of Kapitan Dimitriev is situated in the western part of the Thracian valley. It is a tell with preserved archaeological layers from the Early Neolithic to the Early Bronze Age (Nikolov 1999, 2000). The remains studied within the PLANTCULT project derived from a house belonging to the Early Neolithic II (5650–5450 BC) and were found in a storage vessel (Nikolov 1999), situated close to the hearth together with other storage vessels (fig. 2). The content of all storage vessels has been directly collected. Additionally, bulk samples

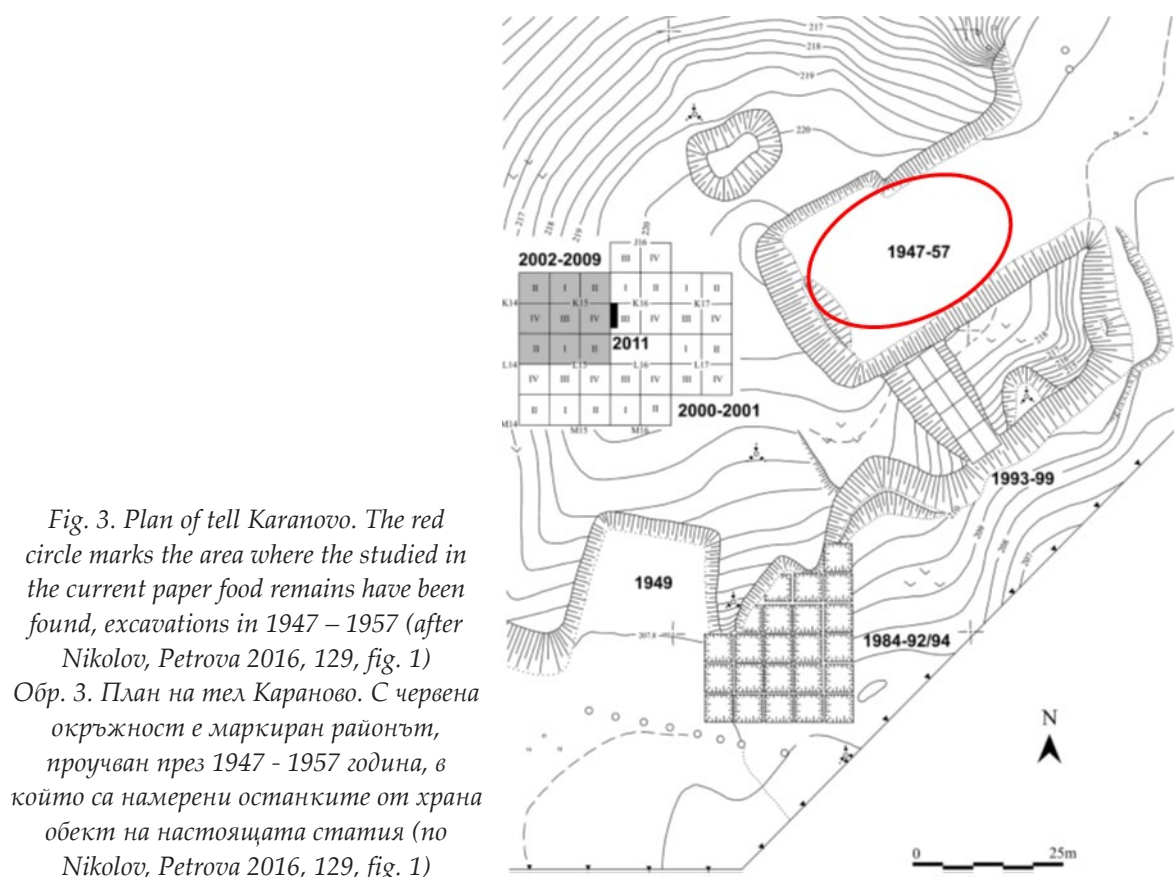


Fig. 3. Plan of tell Karanovo. The red circle marks the area where the studied in the current paper food remains have been found, excavations in 1947 – 1957 (after Nikolov, Petrova 2016, 129, fig. 1)

Обр. 3. План на тел Караново. С червена окръжност е маркиран районът, проучван през 1947 - 1957 година, в който са намерени останките от храна обект на настоящата статия (по Nikolov, Petrova 2016, 129, fig. 1)

have been gathered from the site for flotation and further archaeobotanical analyses.

Karanovo is a tell site situated in the Eastern part of the Thracian valley (fig. 1). It has preserved cultural layers from the Early Neolithic to the Bronze Age (Nikolov 2002). The material studied here comes from storages found on the floor of a building from the level Karanovo V corresponding to 4900–4700 BC (Early Chalcolithic) from the excavated in 1947–57 central sector (fig. 3). During the excavations the content of the vessels was collected as separate samples and stored for further analyses.

Provadia-Solnitsata is also a tell site situated in the Northeastern part of Bulgaria (fig. 1). It is the largest Neolithic-Chalcolithic salt production centre in Europe established, according to reliable series of radiocarbon dates, from 5500 BC onwards i.e. the beginning of the Late Neolithic (Nikolov 2011; 2012; 2017). Three prehistoric layers have been registered at the site: Late Neolithic, Middle Chalcolithic and Late Chalcolithic. In the Southeast sector of the tell the Late Chalcolithic layers have been destroyed during the later periods and were used to form the mound of the Thracian burial tumulus situated on the top of the tell (Nikolov 2010, 2011, 2016). The food remains studied in the current paper come from vessel number 90 found in building 1, square F-4, Southeast sector (fig. 4). They belong to the Middle Chalcolithic layers (4700–4600 BC) of the site. Lots of vessels have been discovered in building number 1 (Nikolov, Petrova 2008). Their content and the sediment around have been systematically sampled. The archaeobotanical material was extracted by the means of manual flotation or more specifically wash-over technique.

Kush Kaya is a hilltop site located in the Eastern Rhodope Mountains, Southeast Bulgaria (fig. 1). Remains of buildings belonging to several periods of inhabitation were un-

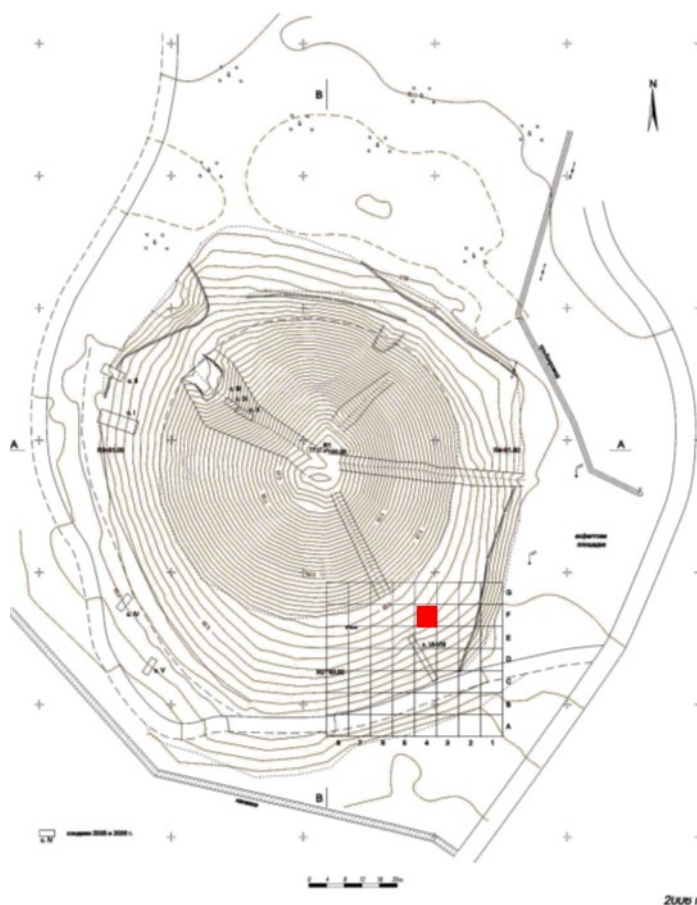


Fig. 4. Topographic plan of the site of Provadia-Solnitsata. The red square points the place of building № 1 where the food remains come from (after Nikolov, Petrova, 2008, 43, fig. 7)

Обр. 4. Топографски план на обекта Провадия-Солницата. Червеният квадрат посочва мястото на сграда № 1, откъдето произлизат останките от храна (по Nikolov, Petrova, 2008, 43, fig. 7)

covered in the study area – the Late Bronze Age, the Early Iron Age and the Roman period. Its occupation was most intensive during the Early Iron Age, when the inhabited area increased considerably (Popov 2006; 2009; 2016).

The studied here food crust comes from a dwelling belonging to the Late Bronze Age layers of sector № 1 of the site (fig. 5.A), and more precisely second half of the 14th – the beginning of the 13th century BC. It was found in a partly preserved, deep vessel, which was covered by part of a jug that was reused as a lid (fig. 5. B, C). The whole content of the vessel has been collected for further analysis. Additionally, bulk samples from different contexts (pits, buildings, cultural layers) of the site have been provided for archaeobotanical analysis. Fragments of clay spoons (fig. 5.D, E), supposedly used for food with liquid texture, were discovered in the same house and in the nearby dwellings (Popov et al. 2018).

The site of Ada Tepe is situated in the Eastern Rhodope Mountains, Southeast Bulgaria (fig. 1). It represents gold mining and settlement complex occupied from the Late Bronze Age to the Early Iron Age (between 15th century BC and beginning of 9th century BC). The site includes ore mining structures (open cast mining structures, waste heaps, working places for ore-preparation, etc.), settlement structures, solitary huts or sheds. The settlement structures are situated in different parts of the hill (fig. 6) and the occupation area during the Early Iron Age decreased significantly as compared to the Late Bronze Age. (Nikov et al. 2018). The study area has been systematically sampled for archaeobotanical analysis. In one of the flotation samples amorphous fragments have been selected as possible food remains. They come from the floor layer of a settlement structure from the Early

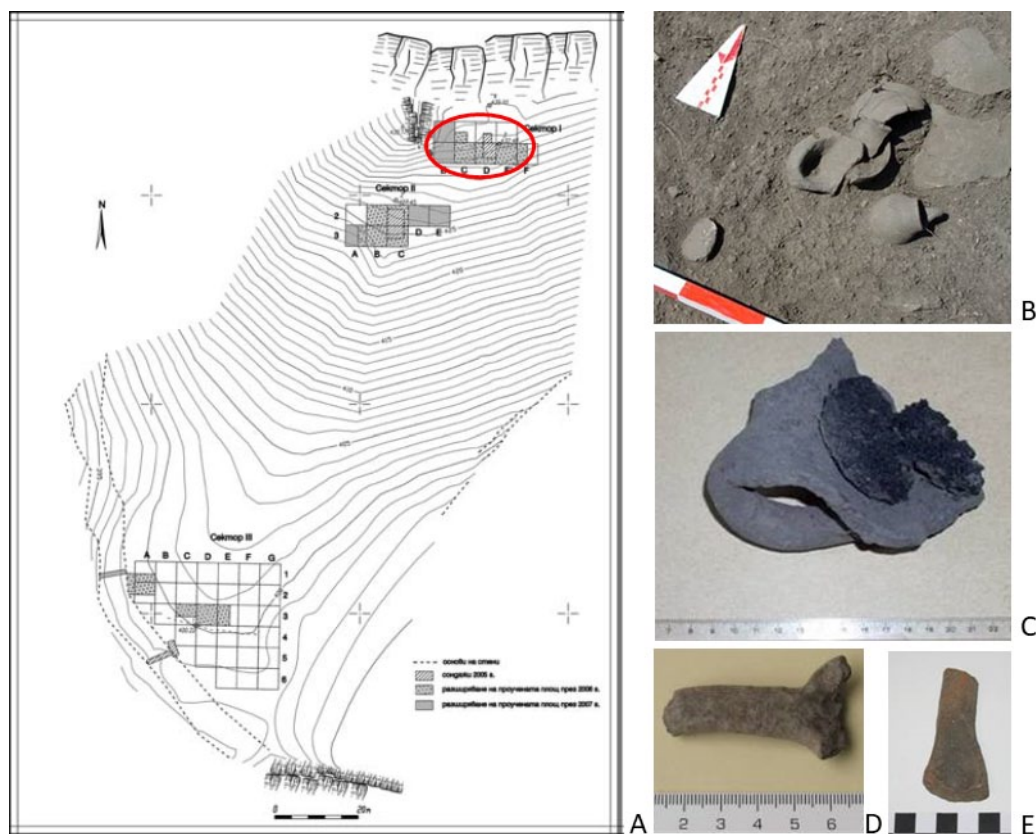


Fig. 5. The site of Kush Kaya: A. Plan of the site Kush Kaya (after Popov 2009, 23, fig. 3). Sector I, where the food remains comes from is marked with red circle; B. Overview of the archaeological context where the food remains were found in dwelling № 1, sector I (after Popov et. 2018, 264, fig. 16.1); C. The same food remains documented as found in situ inside a vessel (after Popov et. 2018, 273, fig. 16.4 A); D and E. Fragments from clay spoons (by H. Popov)

Обр. 5. Обектът Куш Кая: А. План на обекта Куш Кая (Попов 2009, 23, обр. 3). Сектор I, откъдето произхождат останките от храна е маркиран с червена окръжност; В. Общ изглед на контекста на намиране на хранителните останки в жилище № 1, сектор I (по Попов et al. 2018, 264, обр. 16.1); С. Същите останки от храна документиран при откриването in situ в съд (по Попов et al. 2018, 273, fig. 16.4 A); D и E. Фрагменти от глинени лъжици (автор Х. Попов)

Iron Age period of the site (1000–850 BC).

The site Kapitan Andreevo is located on the riverbank of the Maritsa river, Southeast Bulgaria, on the Bulgarian-Turkish border (fig.1). The preserved site structures are pits that chronologically cover the following periods: Early Bronze Age, Early Iron Age, and Early Medieval times. Many of the studied structures belong to the Early Iron Age, 10th–6th century BC (Popov et al. 2007; Popov, Grozdanova 2008) (fig. 7). Fragments of amorphous lumps have been detected in one of the floated samples from pit 176 (fig. 7.B), latterly defined as food remains (fig. 15.A), dated to the Early Iron Age 1000–850 BC.

Vaskovo is situated in Southeast Bulgaria, Ljubimets region close to the Bulgarian – Turkish border. (fig. 1). It is an Early Iron Age house, the size of which is 9,5 x 4,5 m. (fig. 8.A). The site is dated to 10th–9th century BC. The archaeological material is characterized by great diversity: ceramic vessels; loom weights; spindle-whorls; stamp for decoration of vessels; iron knives, etc. (Iliev 2015). A fireplace was found approximately in the middle of

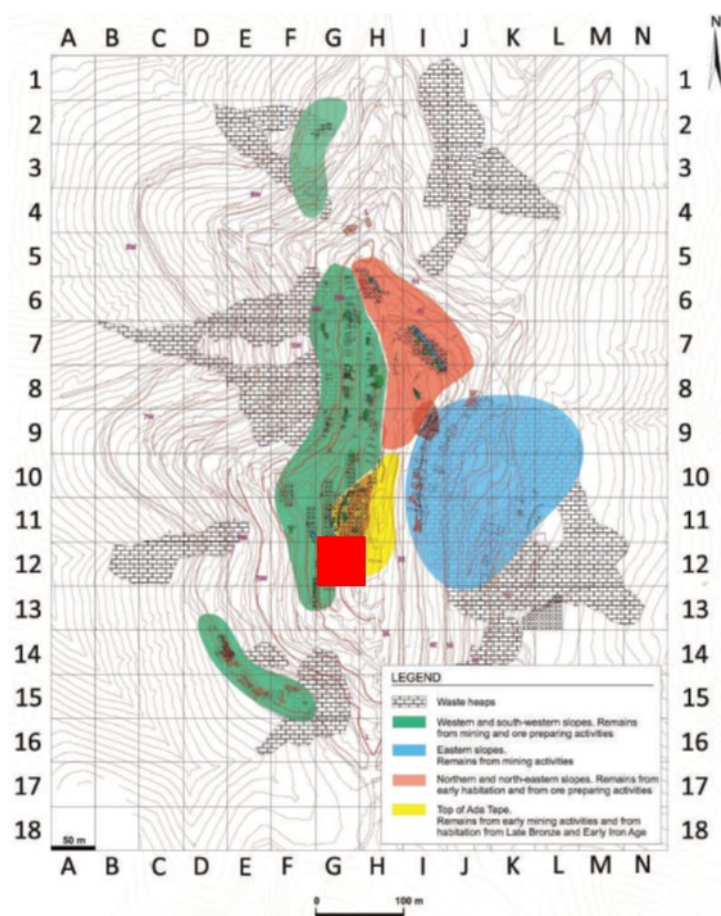


Fig. 6. Plan of the Ada tepe site (after Nikov et al. 2018, 281, fig. 17.2). The red square points the sector where the food remains come from

Обр. 6. План на обекта Ада тене (по Nikov et al. 2018, 281, fig. 17.2). Червеният квадрат посочва сектора, от който произлизат останките от храна

the structure. All the archaeobotanical samples come from the area close to the fireplace (fig. 8. B, C, D).

Methods of analysis

The archaeological food remains have been studied with the aid of a stereomicroscope with magnification 10x–40x. More detailed analysis has been performed using reflected light microscope and documented using SEM. SEM analysis was carried at the Aristotle University of Thessaloniki using a JEOL JSM-840A scanning electron microscope. Samples were coated with carbon – average thickness of 200 Å – using a vacuum evaporator JEOL-4X. Few specimens from Karanovo and Kush Kaya were observed under JEOL JSM 840, coated with 20–25 nm of gold at the Royal Belgian Institute for Natural Sciences.

The cereal based food remains described below follow the classification proposed by Valamoti et al. (2019) with small additions and changes needed for the appropriate description of the proposed here material (Table 1). In addition, a detailed overview of the archaeobotanical assemblages from each site is provided in order to enlarge our awareness of the potential ingredients of the foods consumed by the ancient societies.

Results

Kapitan Dimitriev

The archaeobotanical analysis of the site Kapitan Dimitriev shows that the hulled

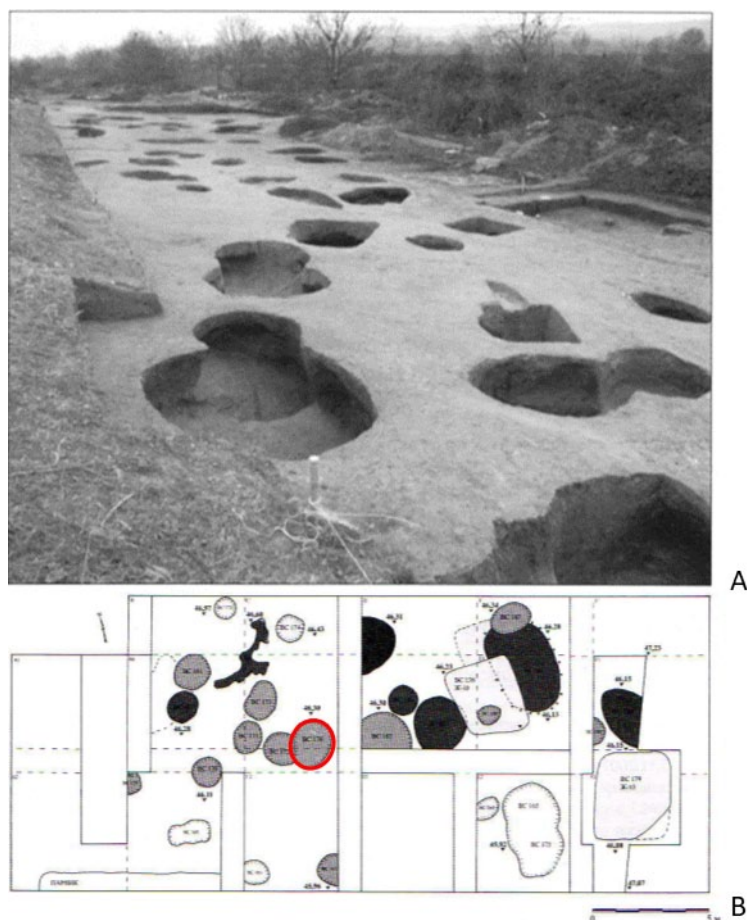


Fig. 7. The site of Kapitan Andreevo: A. Sector of the site of Kapitan Andreevo, where the concentration of Early Iron Age pits is the highest (after Popov et al. 2007, 195, fig. 1); B. Plan of the sector (after Popov, Grozdanova 2008, 164, fig. 1), negative structure 176, where the cereal based food remains were found is marked with red circle

Обр. 7. Обект Капитан Андреево: А. Сектор на обекта Капитан Андреево, с най-висока концентрация на ямите от ранната желязна епоха (по Попов et al. 2007, стр. 195, обр. 1); В. План на сектора (по Попов, Грозданова 2008, с. 164, фиг. 1), яма 176, където са намерени хранителните останки от зърнени култури, е маркирана с червена окръжност

wheats were the most common cereal crops at the site, and the prevailing one was einkorn (*Triticum monococcum*). Both hulled (*Hordeum vulgare* var. *vulgare*) and naked barley (*Hordeum vulgare* var. *nudum*) were present, among which hulled was predominant. Apart from the cereals, pulses were also cultivated. Most important of them were lentil (*Lens culinaris*) and grass pea (*Lathyrus sativus/cicera*). Interesting are the findings of chickpea (*Cicer arietinum*) in the Early Neolithic II layers, synchronous to the studied here material. Chickpea belongs to the early Neolithic founder crop assemblage of the Near East, but in Bulgaria it occurs first in the second half of the early Neolithic parallel to renewed intensification of the contacts with Anatolia as observed in archaeological records (Marinova, Popova 2008). Other interesting archaeobotanical finds from the site are those of the Early Neolithic downy safflower (*Carthamus* cf. *lanatus*) and the Late Neolithic coriander (*Coriandrum sativum*) which show the continuous Mediterranean influence at the site (Marinova 2006a, b; Marinova, Riehl 2009). Gathered plants from the wild were also used, such as *Cornus mas*, *Rubus* sp., *Pistacia terebinthus*, *Physalis alkekegi*, *Prunus* sp., *Corylus avellana*, *Sambucus* sp. (Marinova 2007).

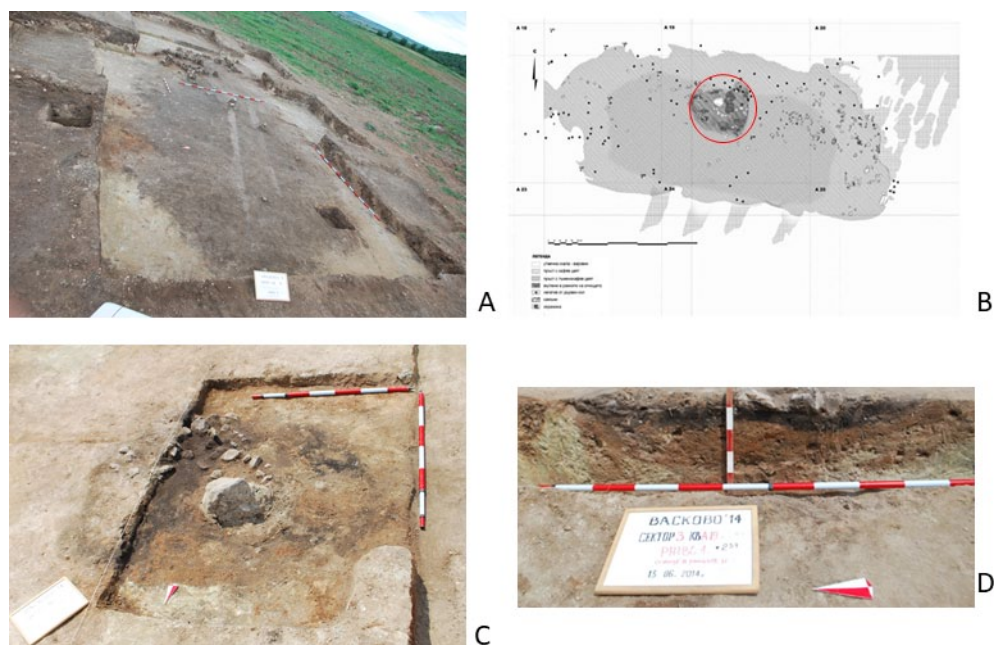


Fig. 8. The site of Vaskovo: A. Photo of the studied structure/ house (by S. Iliev); B. Plan of the studied structure/ house (after Iliev 2015, 159, fig. 1). The area of the fireplace, where the studied here cereal food remains come from, is marked with red circle; C. View of the fireplace (by S. Iliev); D. Section of the fireplace (by S. Iliev)

Обр. 8. Обектът Васково: А. Снимка на изследваната структура/ къща (автор С. Илиев); В. План на изследваната структура/ къща (по Илиев 2015, 159, fig. 1). Огницето, откъдето произхождат разглежданите останки от зърнена храна, е маркирано с червена окръжност; С. Общ изглед на огницето (автор С. Илиев); Д. Профил на същото огнище (автор С. Илиев)

The hulled wheats were usually found as complete ears or at least spikelets (see Marinova 2006a, fig. 4; 2006b, Appendix 1). In some of the storage finds cereal stems were identified, as well as some weeds (Marinova 2006b). Storages of leguminous crops were also present at the site. The content of storage vessel № 4 differed from the others found in the house as it comprised coarsely ground and broken grains of wheat and barley, which were identified during the excavations as a kind of cereal food product, possibly bulgur. The Kapitan Dimitriev food fragments represent a dense concentration stored inside a pot. It is unlikely that all the fractures occurred due to depositional or post-depositional processes, rather the cereals were intentionally processed and deposited there (Marinova 2006b; Marinova 2007). They appear like coarsely ground cereal grains (fig. 9.A). Within the vessel few whole grains (ca. 5% of the volume) were also found and were identified as einkorn, emmer and barley. Part of them could represent unground grains from the storage, but it is also possible that during the burning of the building some grains came in from the other crop storages nearby. Some of the studied food fragments show obvious bulging surfaces and fused endosperm cells (fig. 9.B, C, D, E), while other fragments do not possess features (fig. 9.F, G) that could be related to special processing steps or taphonomic issues (for example post depositional fragmentation). However, observations on rounded or “bulging” surfaces are difficult to be measured objectively (see Braadbaart et al. 2016 and references cited there). A previous study (Valamoti et al. 2008) considered the alterations of the microstructure of those food remains. By application of SEM it was possible to recognise

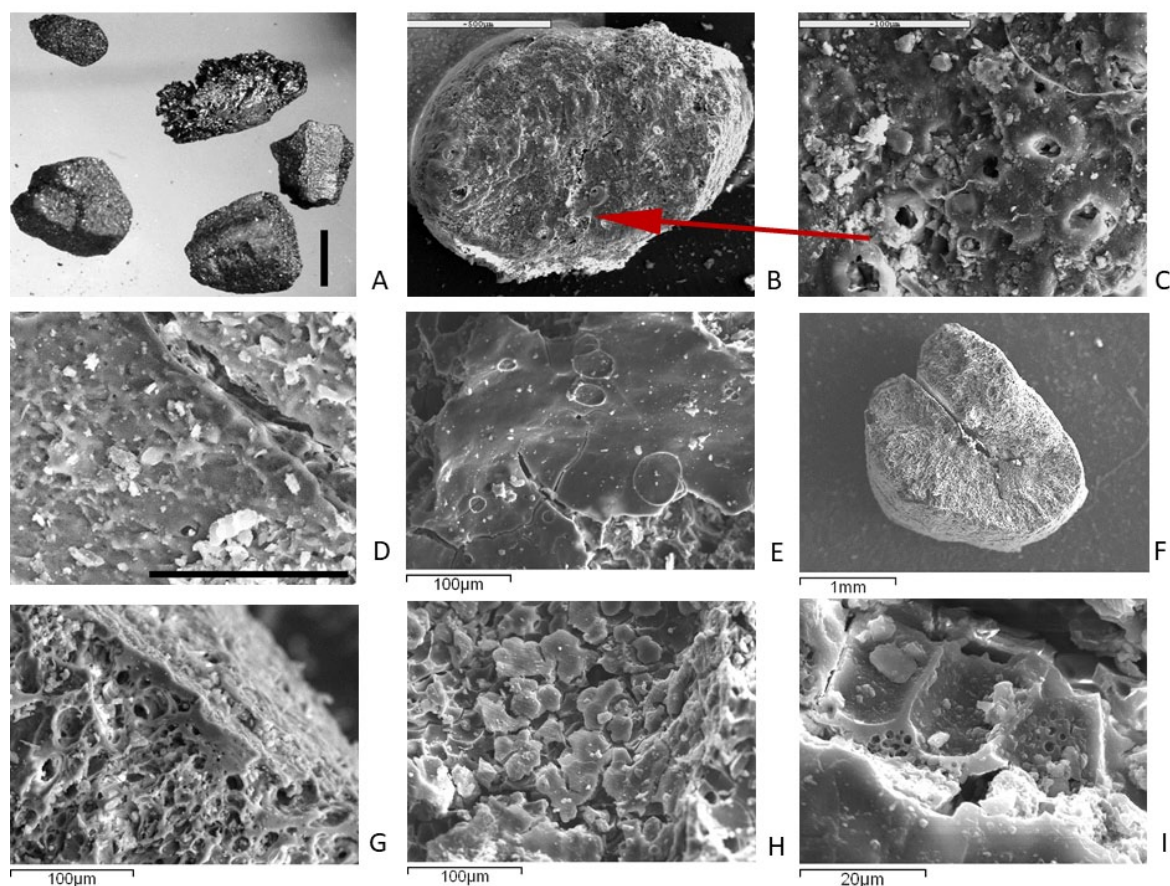


Fig. 9. Microphotographs of food remains from the Early Neolithic site Kapitan Dimitrievo: A. Macroscopic overview of food fragments under low magnification binocular, scale 1 mm (by I. Hristova); B. Macroscopic overview of a food fragment under SEM, scale 500 µm (after Valamoti et al 2019, 102, fig. 2b.); C. Magnified detail from the same structure given in B. (after Valamoti et al 2008, 274, fig. 18); D. Microstructure showing bulging surfaces and fused endosperm cells, scale 100 µm; E. Possible remains of gelatinization on the grain fragment surface; F. Einkorn (*Triticum monococcum*) grain fragment showing no traces of processing; G. Close view on presumably unprocessed grain fragment; H. Partly collapsed and molten aleurone layer; I. Preserved aleurone layer (photos D–I by L. Papadopoulou, I. Hristova)

Обр. 9. Микрофотографии на останки от храна от Ранния Неолит на Капитан Димитриево: А. Общ изглед на фрагменти от храната при ниско увеличение (под бинокуляра), мащаб 1 mm (автор И. Христова); В. Общ изглед на фрагмент от храната под SEM, мащаб 500 µm (по Valamoti et al. 2019, 102, fig. 2b); С. Увеличен детайл от същата структура, дадена в В. (по Valamoti et al 2008, 274, fig. 18); Д. Микроструктура, показваща изпъкнали повърхности и слети ендоспермни клетки, мащаб 100 µm; Е. Възможни останки от желатинизация върху повърхността на фрагмента на зърното; Ф. Фрагмент от зърно на еднозърненка (*Triticum monococcum*), без следи от обработка; Г. Близък план върху вероятно необработван фрагмент от зърно; Н. Частично разрушен и разтопен алеуронон слой; И. Запазен алеуронон слой (снимки D–I, Л. Пападопулу, И. Христова)

and describe a wide range of starch forms with traces of uneven cooking processes, thus it was suggested that the cereal grain fragments were cooked in water (Valamoti et al. 2008). The current analysis has shown that one layered aleurone tissues (fig. 9.H, I) are quite common among the preserved microstructures visible under SEM, which points to cereals different from barley. Except from barley the other cereals present in the vessel were einkorn and emmer, which indicates them as possible ingredients of the studied food remains.

Karanovo

The archaeobotanical analyses at Karanovo comprise different periods (Arnaudov, Vassileva 1947; Hopf 1973; Popova 1995; Thanheiser 1997; Marinova 2002, 2004, 2005). The Neolithic and Chalcolithic crop spectrum is quite similar to that described above for Kapitan Dimitriev. The prevailing cereal crops are the hulled wheats, which most probably were grown together. The domination of einkorn and emmer varies throughout the periods of existence of the site (see Marinova 2006b). For the time of interest, the Early Chalcolithic, einkorn (*Triticum monococcum*) was prevailing (Marinova 2005). Barley (*Hordeum vulgare*) had a secondary role and usually was found in small amounts. Leguminous crops were also an important part of the diet of the prehistoric population. The most typical leguminous crops during the Chalcolithic are lentil (*Lens culinaris*) and bitter vetch (*Vicia ervilia*). Pea (*Pisum sativum*) and grass pea (*Lathyrus sativus/cicera*) were identified but in much smaller quantities. The analysis of several storages from the Late Neolithic documented that unprocessed einkorn (*Triticum monococcum*) and emmer (*Triticum dicoccum*) were stored together, while pulses were found as separate concentrations (storages) of pea, grass pea and lentil. The only oil/ fiber plant found at the site was linseed (*Linum usitatissimum*) (Marinova 2005). Gathered plants were also used by the site's inhabitants such as Cornelian cherry (*Cornus mas*), elder (*Sambucus* sp.), strawberry (*Fragaria vesca*), raspberry (*Rubus idaeus*), plums (*Prunus* sp.), wild grape (*Vitis vinifera*) (Marinova 2006a).

When observed under low magnification (10x–40x) the preserved food remains appear like ground cereal fragments about half mm in size, most of which were lumped together but separate ones were also visible (fig. 10.A, B, C). They could point to pre-cooked ground cereals that fused together during charring. Several separate cereal fragments and lumps have been selected for examination under SEM. In some of the lumps, parts of cereal grains were visible (fig. 10.A-D). The observed aleurone fragments were single- and multi-layered (fig. 10.E, F). Partially preserved glume parts were also observed (fig. 10.D, F). The multiple layered peripheral aleurone (Hands et al. 2012) could be considered as clear evidence for presence of barley in the mixture. Numerous cereal bran parts and sometimes transverse cell patches were observed (fig. 10.D, G, H). In most of the cases, the transverse cell patches are difficult to be identified, but a well-preserved example closely resembles *Triticum* sp. (fig 10.H). Considering the morphology of those transverse cells, the presence of single-layered aleurone, and the archaeobotanically attested cereal species at the site it could be suggested that wheat was the other ingredient of the prepared food. As free threshing wheats (*T. aestivum/durum*) have been found only as single grains (Marinova 2005) it could be inferred that the wheat ingredients of the discussed here cereal food were the hulled wheats (*Triticum monococcum/dicoccum*). Additionally, observed pores and fused endosperm cells (fig. 10.C, I) should reflect some cooking processes or the result of charring.

Provadia-Solnitsata

Based on the archaeobotanical investigations, einkorn (*Triticum monococcum*) and emmer (*Triticum dicoccum*) are the cereals of greatest importance. In the Middle Chalcolithic storage contexts dominated by einkorn, 14 % of the glume bases belong to the “new wheat type” as defined by Jones et al. (2000) resembling *Triticum timopheevi* Zhuk., a cereal crop recognised already at several sites in Bulgaria (Marinova 2011; Marinova, Valamoti 2014; Kreuz, Marinova 2017). Barley (*Hordeum vulgare*) was also common for the site. Apart from cereals, pulses took an important part of the crops at the site. Most abundant were grass pea (*Lathyrus sativus/cicera*) and bitter vetch (*Vicia ervilia*), and to a lesser extend lentil (*Lens culinaris*). Gathered plants such as Cornelian cherry (*Cornus mas*), elder (*Sambucus* sp.), rasp-

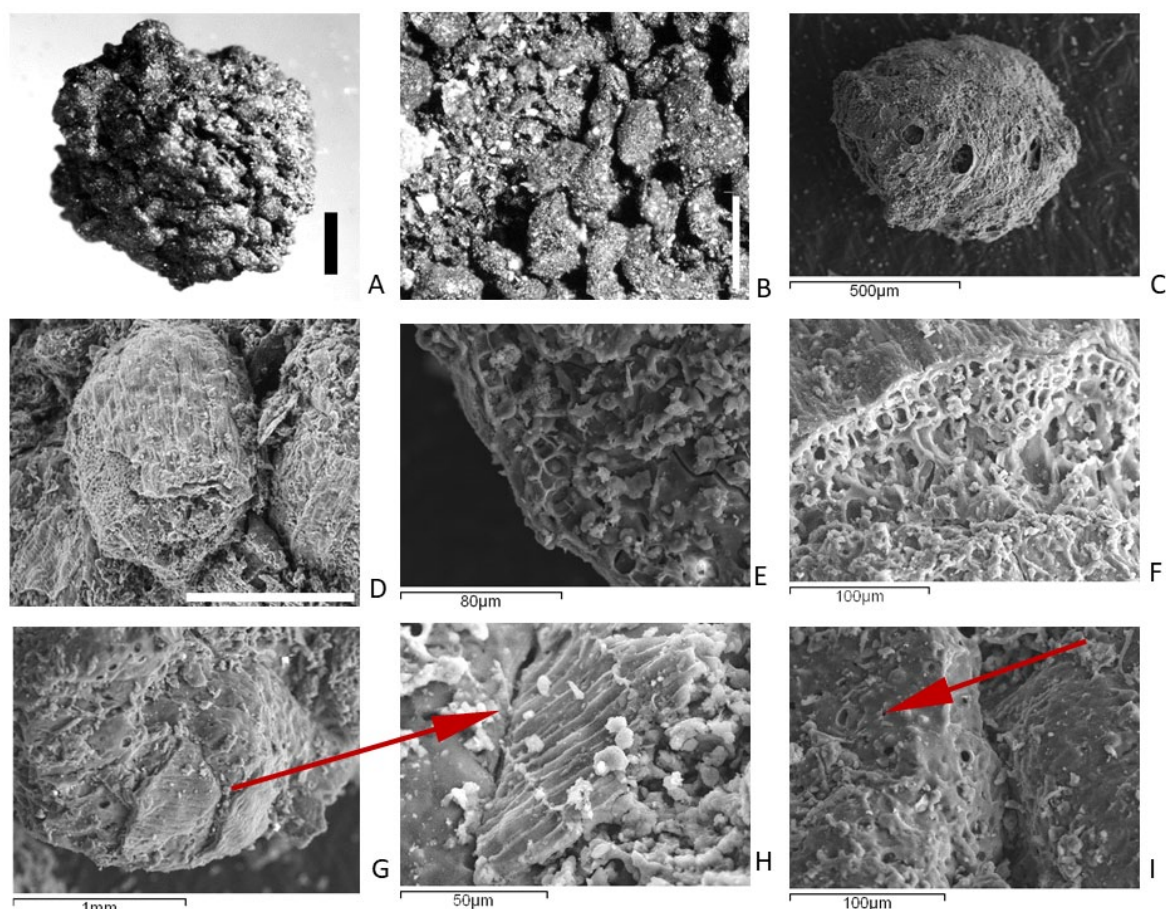


Fig. 10. Microphotographs of food remains from the Early Chalcolithic period in Karanovo: A. Macroscopic overview of a food fragment under low magnification binocular, scale 1 mm (after Valamoti et al. 2019, p.102, fig. 6a); B. Macroscopic overview of cereal fragments lumped together, scale 1 mm (by I. Hristova); C. Macroscopic view of a food fragment under SEM with traces of bulging (and thus possible traces of boiling); D. Grain fragment with visible aleurone, pericarp, eroded glume, and transversal cells layer sections, scale 400 µm; E. Close view of a single aleurone layer F. Partially preserved glume of barley (cf. *Hordeum*) and the aleurone layer; G, H. Preserved bran fragments and transverse cells; I. Detailed view of partly gelatinized starch granules (photos C–I by L. Papadopoulou, I. Hristova)

Обр. 10. Микрофотографии на останките от храна от ранния халколит на Караново: А. Общ изглед на фрагмент от храната при ниско увеличение (под бинокулар), мащаб 1 mm (по Valamoti et al. 2019, p.102, fig. 6a); В. Фрагменти от житни зърна, слепени в едно, мащаб 1 mm (автор И. Христова); С. Фрагмент от храната под SEM със следи от издуване (и следователно с възможни следи от варене); D. Фрагмент от житно зърно със сектори с видим алеурон, перикарп, разрушена плява и слой на напречните клетки на перикарпа, мащаб 400 µm; E. Близък план на единичен алеуронон слой; F. Частично запазена плява на ечемик (cf. *Hordeum*) и алеуронония слой; G, H. Запазени фрагменти от обвивката на зърното и напречните клетки на перикарпа; I. Детайл на частично желатинизирани нишестени гранули (снимки C–I, Л. Пападополу, И. Христова)

berry (*Rubus idaeus*), wild grape (*Vitis vinifera*) were also found at the site (Marinova 2008).

The material defined as possible food remains comprises cereal fragments about 1 to 2 mm in size which have lost most of their structure, but some still could be recognized as such (fig. 11). Many had fused together in small lumps and show homogenous porous texture (fig. 11.B, D). On some of the fragments aleurone layers (fig. 11.E, F) are visible. When observed in cross section some of the aleurone tissues reveal multiple cell rows (fig.

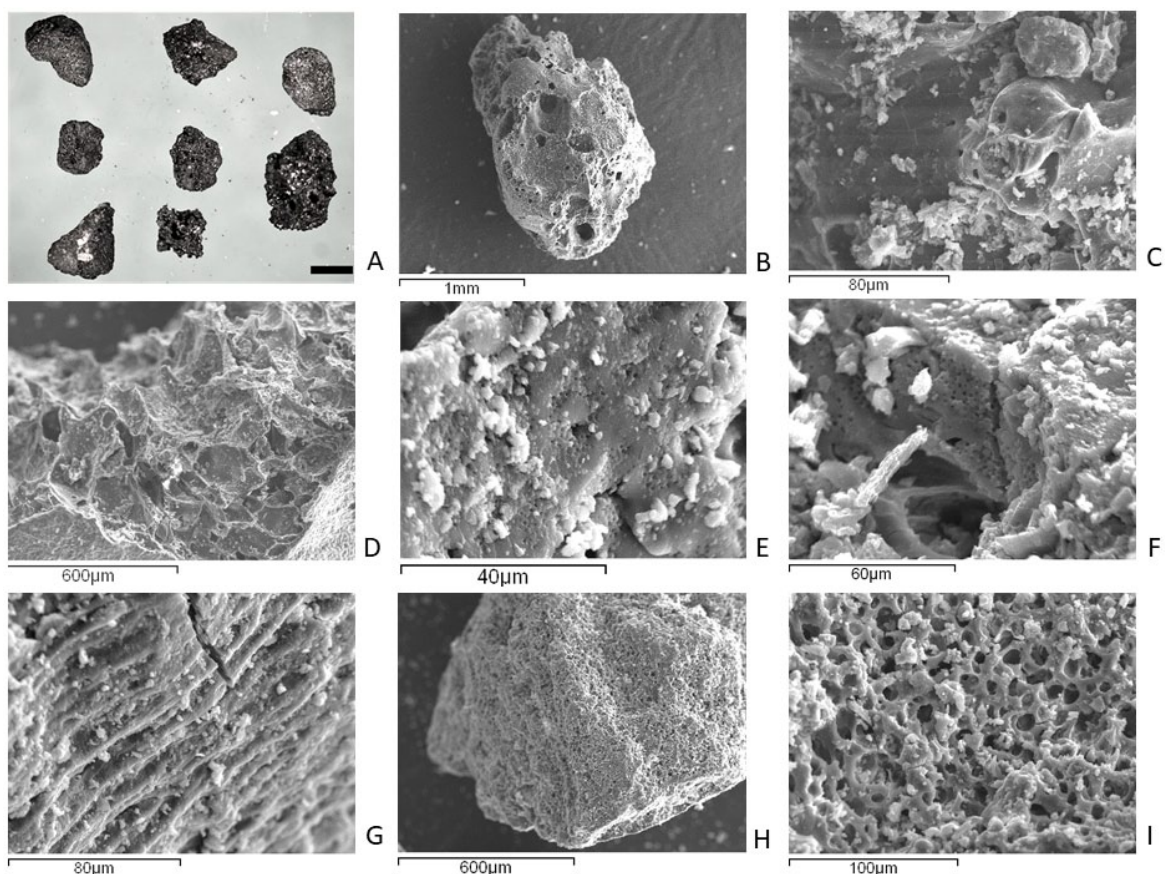


Fig. 11. Microphotographs of food remains from the Middle Chalcolithic in Provadia-Solnitsata: A. Macroscopic overview of food fragments under low magnification binocular, scale 1 mm (after Valamoti et al. 2019, 104, fig. 7a); B. Overview of a food fragment under SEM; C. Possibly gelatinized surface with fused endosperm cells and pores; D. Cereal grain fragment with fused endosperm; E. Preserved aleurone layer; F. Multiple row aleurone layer in cross section; G. Close view of the surface of a cereal grain fragment with preserved bran fragments; H. Cereal grain fragment with fine porous texture; I. The same fragment as in H, but in detail and under higher magnification (photos B–I by L. Papadopoulou, I. Hristova)

Обр. 11. Микрофотографии на останки от храна от средния халколит на Провадия– Солницата: А. Общ изглед на фрагменти от храната при ниско увеличение (под бинокулар), мащаб 1 mm (Valamoti et al. 2019, 104, fig. 7a); В. Снимка на фрагмент от храната със SEM; С. Вероятно желатинизирана повърхност със слети ендоспермни клетки и пори; D. Фрагмент от житно зърно със слети клетки на ендосперма; Е. Запазен алеуронон слой; F. Многопластов алеуронон слой в напречен разрез; G. Близък план на повърхността на фрагмент от житно зърно със запазени части от перикарпа; H. Фрагмент от храна с фина пореста структура; I. Същият фрагмент документиран в H, но в детайл под по-голямо увеличение (снимки B–I, Л. Пападополу, И. Христова)

11.F) what allows linking them to barley (*Hordeum vulgare*). The lumps could originate from cooking activities as in some fragments fused endosperm cells and pores were noted (fig. 11.C, D). No patches of transverse cells are visible in the studied fragments, but still bran parts are observed (fig. 11.G). Some of the fragments represent very regular porous substance (fig. 11.H, I), which differs from the cereal texture and could represent ingredients other than cereals as component of the prepared food. Ongoing experimental research and observations in the framework of PLANTCULT aim to build criteria for distinguishing different types of seed texture.

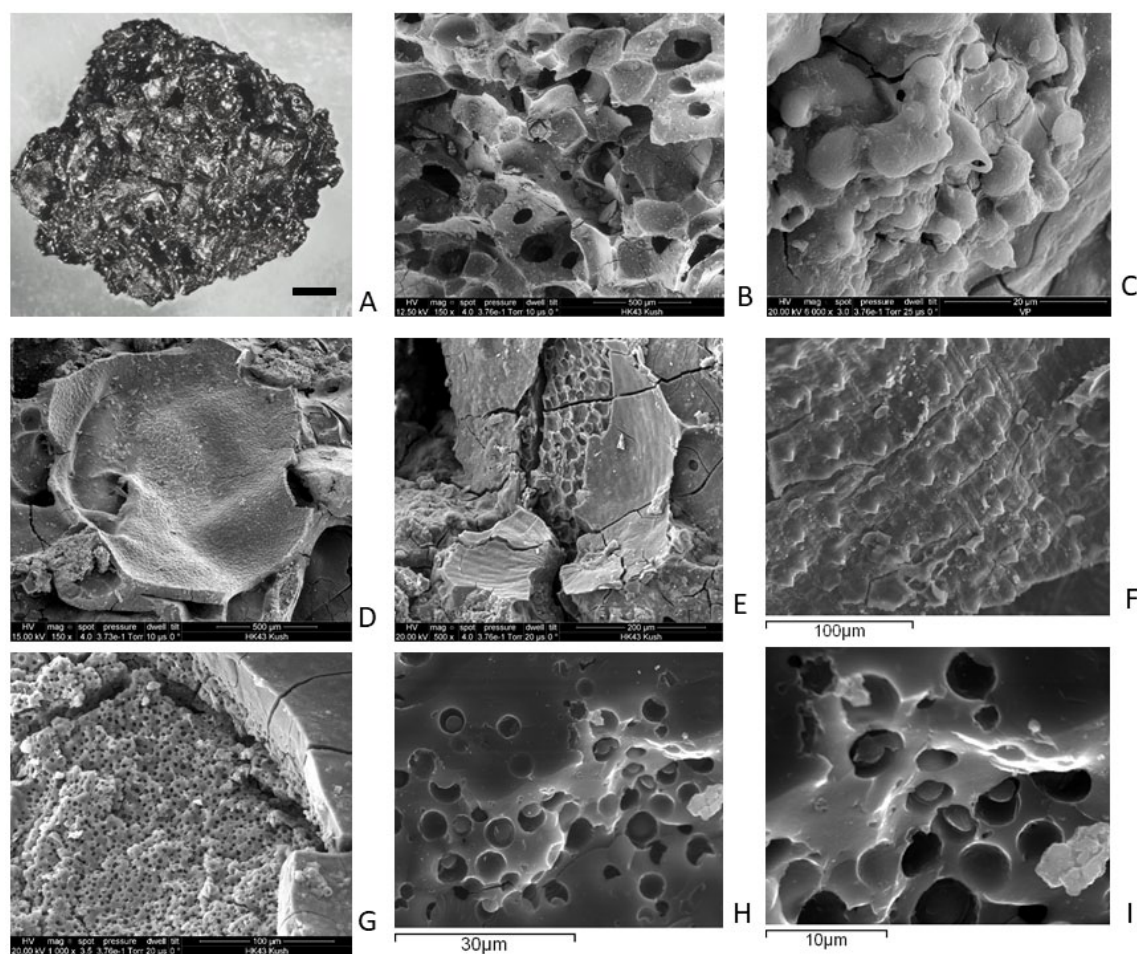


Fig. 12. Microphotographs of food remains from the Late Bronze Age in Kush Kaya: A. Macroscopic overview of a food fragment under low magnification binocular, scale 1 mm (by I. Hristova); B. Food fragment with visible porous texture; C. Detailed view of a location with fused/molten homogenous texture; D. Common millet - bran coat from inside; E. Common millet - bran coat from inside with traces of aleurone layer beneath; F. Glume fragment from *Setaria*; G. Endosperm of common millet with structure possibly altered by heating; H. and I. The same altered structure in detail and under higher magnification (photos B–I by E. Marinova)

Фиг. 12. Микрофотографии на останки от храна от късната бронзова епоха на Куш Кая: А. Общ изглед на фрагмент от храната при ниско увеличение (под бинокуляра), мащаб 1 mm (автор И. Христова); В. Фрагмент от храната с видимо пореста структура; С. Детайл на слята/ разтопена хомогенна текстура на храната; D. Просо – вътрешната страна на обвивката на зърното; Е. Просо – вътрешната страна на обвивката на зърното със следи от алеуринов слой отдолу; F. Фрагмент на плевка на *Setaria*; G. Ендосперм на просо със структура, вероятно видоизменена при нагряването; H. и I. Същата видоизменена структура в детайл при по-високо увеличение (снимки B–I, Е. Маринова)

Kush Kaya

The cereal crops are the dominant group of plant remains found in all studied structures at the site. During the Late Bronze Age millet (*Panicum miliaceum*) is the prevailing crop not only in the site but also in the region (Stika, Heiss 2013). Other common cereals are hulled wheats (*Triticum monococcum/dicoccum*) and hulled barley (*Hordeum vulgare* var. *vulgare*). Emmer (*Triticum dicoccum*) and einkorn (*Triticum monococcum*) are almost equally abundant, with a slight prevalence of the emmer. Pulses are far less common in the archaeobotanical record compared to cereals and are represented by lentil (*Lens culinaris*) and

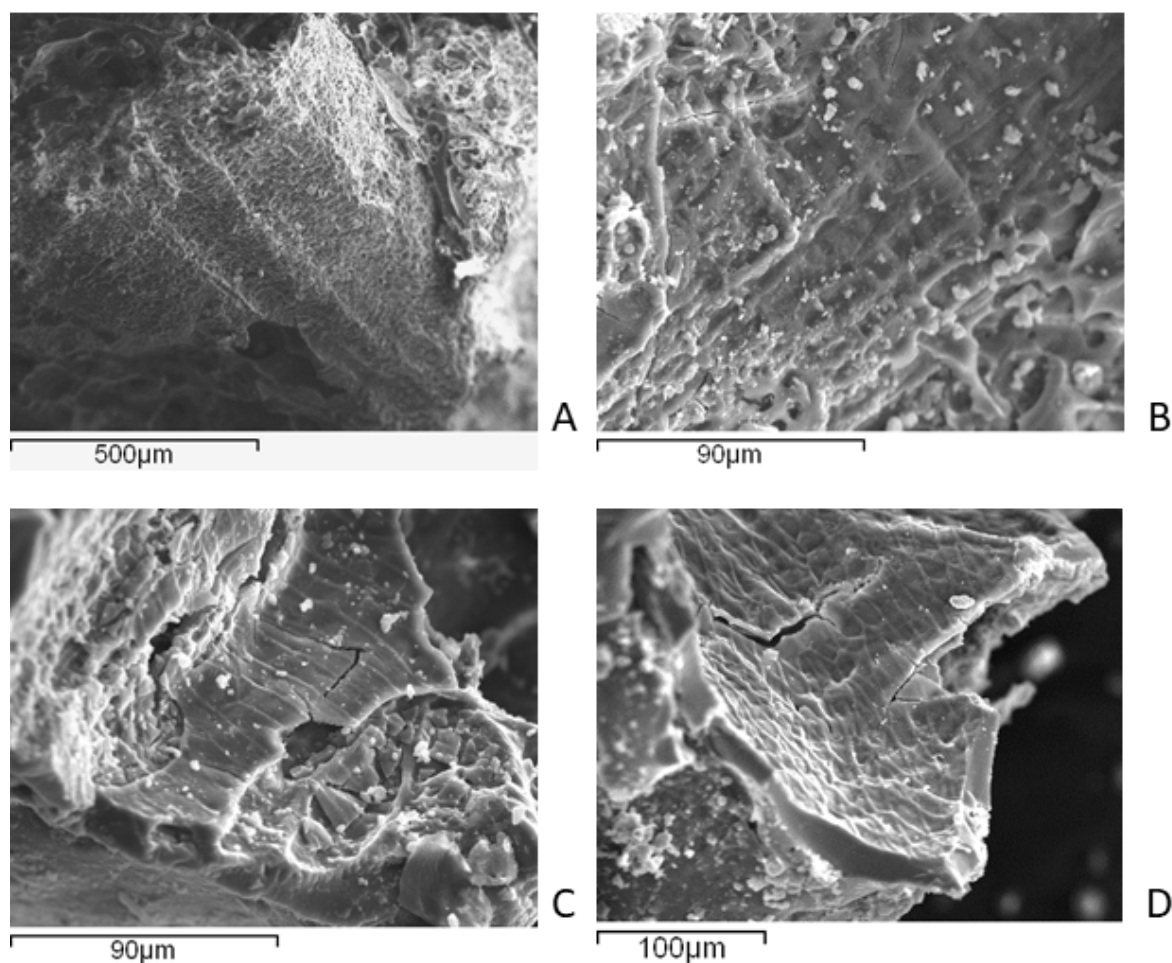


Fig. 13. Microphotographs of food remains from the Late Bronze Age in Kush Kaya: A. Fragmented barley grain incorporated in the food crust matter; B. The interface between longitudinal and transverse cells; C. Longitudinal cells of the pericarp; D. The interface between tubular and longitudinal cells (figure by L. Papadopoulou, I. Hristova)

Фиг. 13. Микрофотографии на останки от храна от късната бронзова епоха на Куш Кая: А. Фрагментирано зърно на ечемик, интегрирано в хранителната материя; В. Слой на прехода между надлъжните и напречните клетки на перикарпа; С. Надлъжни клетки на перикарпа; D. Преход между тръбестите и надлъжните клетки на перикарпа (автори Л. Пападополу, И. Христова)

grass pea (*Lathyrus sativus/cicera*). There is a single find of common beet (*Beta vulgaris*) but it represents quite insufficient evidence for revealing the economic role of the plant. It can be interpreted either as a field weed or as a vegetable. Plants, gathered in the wild, were also part of the Late Bronze Age diet. Most common are the remains of Cornelian cherry (*Cornus mas*). A single find of grape pip (*Vitis vinifera*) is registered which is not sufficient to determine whether this species was cultivated or not (Popov et al. 2018).

The food crust found in a deep vessel in dwelling № 1 has a porous texture, which consists of complete and fragmented grains of millet and barley incorporated in a homogenous charred mass (fig. 12.A, B, C). Linseeds were also recognized but they were rarely found either because they were fewer or because they do not preserve so well and do not produce diagnostic microstructures. The closer observation of all available fragments and visually identifiable components suggests that the dominating ingredient was millet (fig. 12.D, E). Under low magnification and SEM, the charred porous mass possesses quite ho-

mogenous sectors, without any recognizable plant tissue (fig. 12.B, C). Apart from the whole and fragmented grains of millet, also chaff fragments (fig. 12.E, F) were found. Some of the glume fragments were identified as *Setaria* (fig. 12.F). Furthermore, remains of endosperm were detected (fig. 12.G, H, I). Although obviously deformed by high temperatures, they could be associated with millet (Yang et al. 2011). Other portions of tissue resemble possibly highly altered and deformed former endosperm (fig. 12.C). Instead of cellular structure these areas are amorphous even under SEM, displaying cavities containing small spherules. This structure is possibly a consequence of pyrolysis: During this process, organic polymers such as starch, cellulose and hemicelluloses can melt, and pyrolysis gas then leads to the formation of cavities (Greenwood 1967; Boateng et al. 2007; Werner et al. 2014). The deformation rate could be influenced by different factors like moisture/water content and thermal impact before and/or during the burning process. Some experimental studies describe the process of deformation of cereal grain structure at different temperatures and the decomposition of starch granules (Charles et al. 2015; Berihuete-Azorín et al. 2019). At the current state of research, it is important to note that these endosperm deformations cannot clearly be attributed to processes of cooking and/or fermentation, or to processes taking place during charring (Heiss 2019; Heiss et al. 2019), i. e. how much the structure was influenced by the fire. Identified millet grain fragments and chaff remains (fig. 12.D, E, F) as well as barley fragments (fig. 13.A) within the food matrix indicate that they have been processed (crushed?) prior to the charring. Millet chaff is very difficult to remove and often remains as a component of the foodstuff based on millet. Moreover, recent studies of ancient beer remains from China have shown that chaff of millet was present in the brewing admixture of millet, along with barley grains and Job's tears seeds (Wang et al 2016). Additionally, traces of transversal cells, longitudinal cells, and the interface between tubular and longitudinal cells were quite commonly observed within the food matrix (fig. 13.B, C, D). Complete and fragmented linseeds have also been found. Most probably linseed was added to the mixture in order to increase the nutritional value of the food thanks to its high oil content, and at the same time enriching its taste.

Ada Tepe

The main components of the archaeobotanical assemblages are the cereal crops. During the Early Iron Age, the free threshing wheat (*Triticum aestivum/durum/turgidum*), einkorn (*Triticum monococcum*), and barley (*Hordeum vulgare*) are prevailing. The abundance of free threshing wheat is quite interesting as it is not commonly cultivated cereal crop in the region during the the Early Iron Age (Hristova et al. 2017). It points towards contacts with and influences by neighbouring regions like the Near East and the Aegean, where it was one of the main cultivated crops during the period under consideration (Riehl, Nesbitt 2003, 305-306; Megaloudi 2004, 155; Megaloudi 2006, 35, 77-79). Leguminous crops are scarcely presented at the site. The most common one is bitter vetch (*Vicia ervilia*), but also single finds of pea (*Pisum sativum*) and grass pea (*Lathyrus sativus/ cicera*) were attested. Fruits are the most numerous plant group at the site, both cultivated and gathered from the wild. Most common among them are grapevine (*Vitis vinifera*), Cornelian cherry (*Cornus mas*), fig (*Ficus carica*), strawberry (*Fragaria vesca*) and raspberry (*Rubus idaeus*) (Nikov et al. 2018).

Few amorphous lumps with preserved cereal pericarp (fig. 14.A) were found in the Early Iron Age structures of the site. The texture of the studied fragments is quite homogenous without any indication of visible with naked eye whole or fragmented cereal grains (fig. 14.B, C). This could be evidence of more thorough processing. Indirectly it could suggest that the final food product requires fine processing of the ingredients such as nowa-

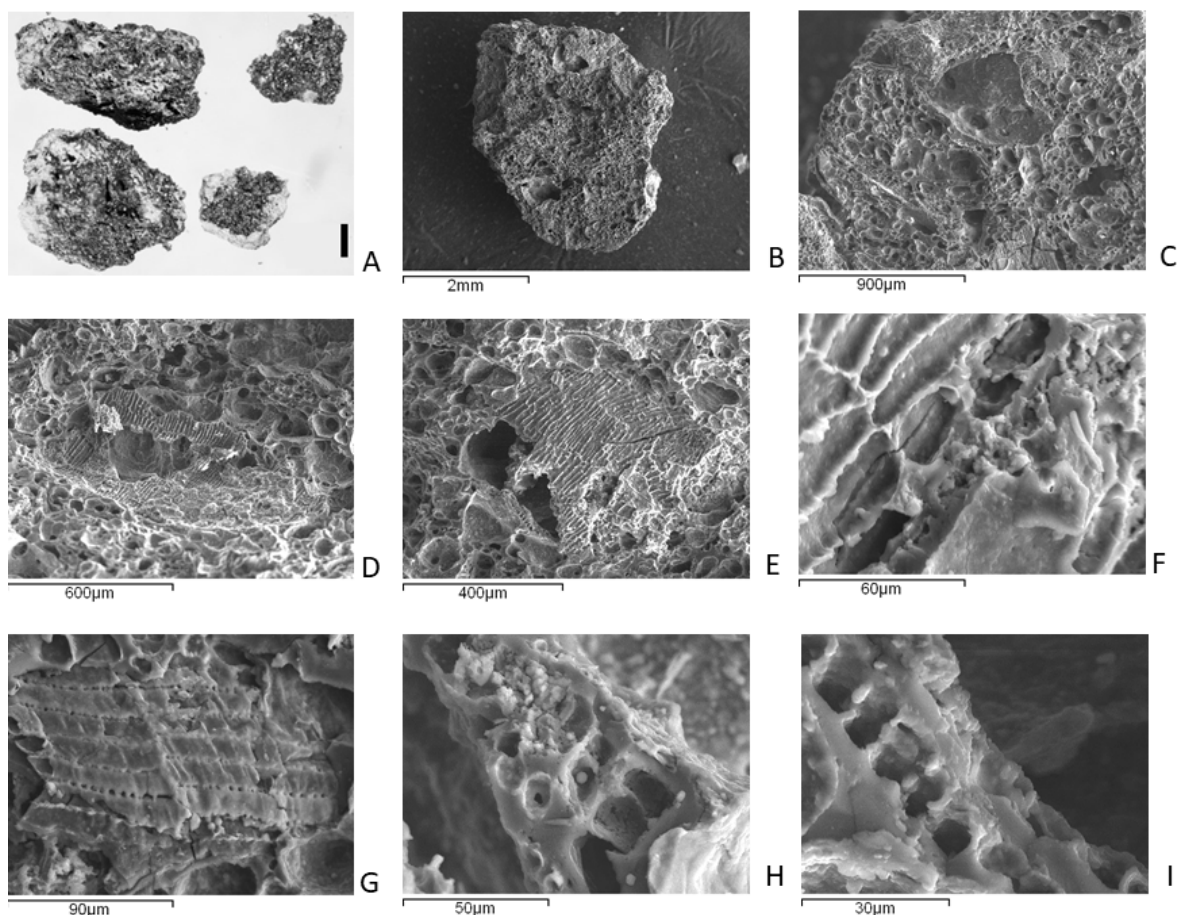


Fig. 14. Microphotographs of food remains from the Early Iron Age in Ada Tepe: A. Macroscopic overview of a food fragments under low magnification binocular, scale 1 mm (by I. Hristova); B. Overview of a food fragment under SEM; C. The same surface presented in B, now in detail with visible cereal tissue fragments; D and E. Preserved pericarp fragments within the food texture; F. Detailed view of the transverse cell layer of wheat (*Triticum* sp.) pericarp; G. Detailed view of transverse cells; H. Preserved multiple layered aleurone; I. Preserved single layered aleurone (photos B–I by L. Papadopoulou, I. Hristova)

Фиг. 14. Микрофотографии на останки от храна от Ранната желязна епоха на Ада Тепе: А. Общ изглед на фрагменти от храната при ниско увеличение (под бинокъл), мащаб 1 mm (автор И. Христова); В. Снимка на фрагмент от храна под SEM; С. Същата повърхност, представена в В, но в детайл с видими фрагменти от тъканите на житното зърно; D и E. Запазени фрагменти от перикарп на културно житно растение в структурата на храната; F. Детайл на напречния клетъчен слой на перикарпа на пшеница (*Triticum* sp.); G. Детайл на напречни клетки; H. Запазен многослоен алеурон; I. Запазен еднослоен алеурон (снимки B–I, Л. Пападопулу, И. Христова)

days bread, flour, etc. Numerous bran coats with preserved transverse cells could be observed inside the food remains (fig. 14.D, E, F, G) some of which could be determined as wheat (*Triticum* sp.) (fig. 14.E, F). Evidence of both multiple and single layered (fig. 14.H, I) aleurone gives a hint towards the multicomponent structure of the studied cereal-based food product, at least wheat and barley.

Kapitan Andreevo

The archaeobotanical results for the Early Iron Age at the site are based on several studied samples. The staple crops during that period are barley (*Hordeum vulgare*) and the hulled wheats among which einkorn (*Triticum monococcum*) was prevailing. Einkorn is usually the major wheat among the hulled wheats in the region during the Early Iron Age

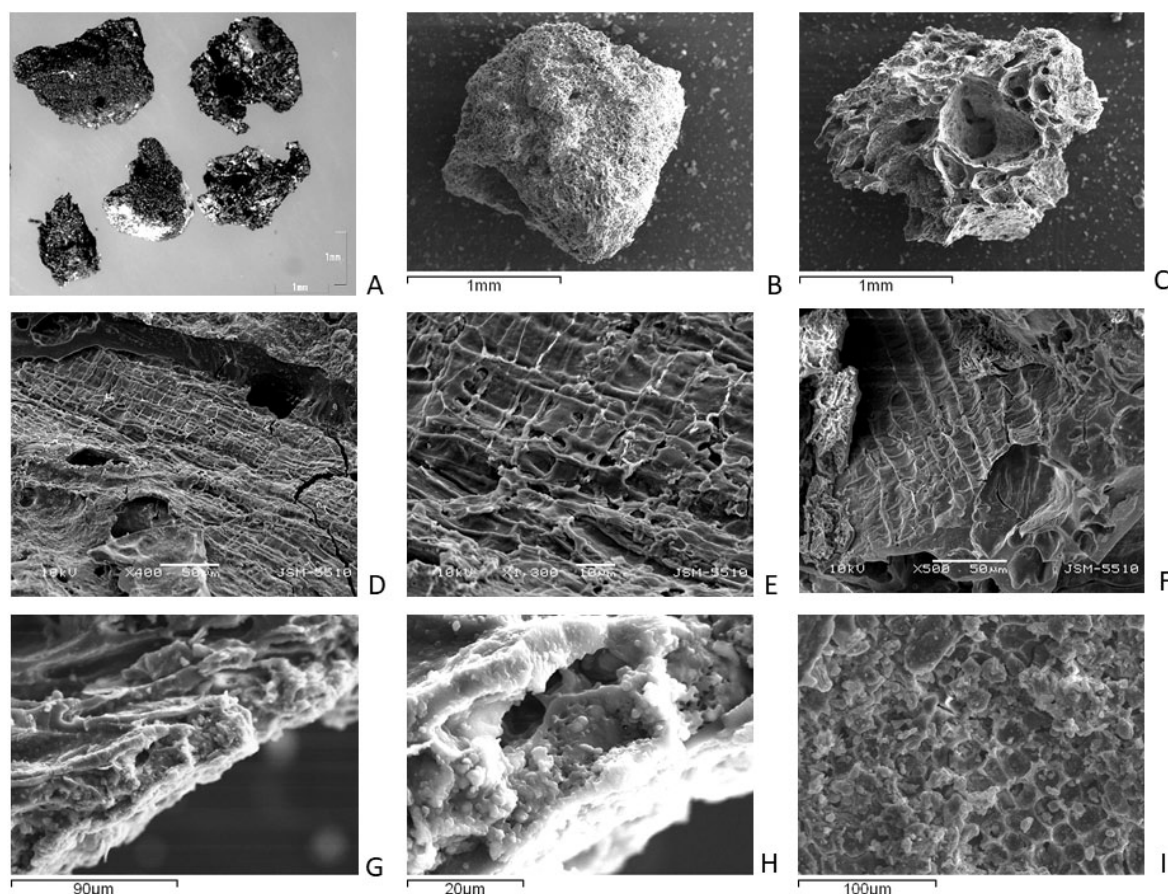


Fig. 15. Microphotographs of food remains from the Early Iron Age in Kapitan Andreevo: A. Macroscopic overview of food fragments under low magnification binocular, scale 1mm (after Valamoti et al. 2019, 108, fig.19a); B and C. Macroscopic overview of a food fragment under SEM; D, E, F. View of the interface between transverse and longitudinal cells; G. Preserved multiple row aleurone layer (two layers are visible); H. Closer view of G under higher magnification (after Valamoti et al. 2019, 108, fig. 19 c); I. Traces of aleurone layer (photos B–G, I by L. Papadopoulou, I. Hristova)

Обр. 15. Микрофотографии на хранителни останки от Ранната желязна епоха на Капитан Андреево: А. Общ изглед на фрагментите от храна при ниско увеличение (под бинокулар), мащаб 1 mm (по Valamoti et al. 2019, 108, fig.19a); В и С. Общ изглед на фрагмент от храната под SEM; D, E, F. Снимка на прехода между напречните и надлъжните клетки; G. Запазен многословен алеуринов слой с видими два пласта; H. Изглед под по-голямо увеличение на същата структура показана в G (по Valamoti et al. 2019, 108, fig. 19 c); I. Следи от алеуринов слой (снимки B–G, I, Л. Пападопулу, И. Христова)

(Hristova et al. 2017). Towards the transition period to the Late Iron Age millet (*Panicum miliaceum*) gains importance and gradually reaches dominance over einkorn. Leguminous crops are represented only by a single find of grass pea (*Lathyrus sativus/ cicera*), and fruits – by a single find of grape pip (*Vitis vinifera*). Of great interest is the discovery of an olive stone (*Olea europea*) which is considered as an import as it cannot grow and give fruits in the study area.

The texture of the food fragments studied here is quite homogenous (fig. 15.B, C) which could be an indication of more elaborate processing such as fine grinding and/or sieving of the ingredients prior to further preparation of the meals. Preserved cereal pericarp is observed in some of the fragments (fig. 15.D, E, F). The homogenous texture is quite

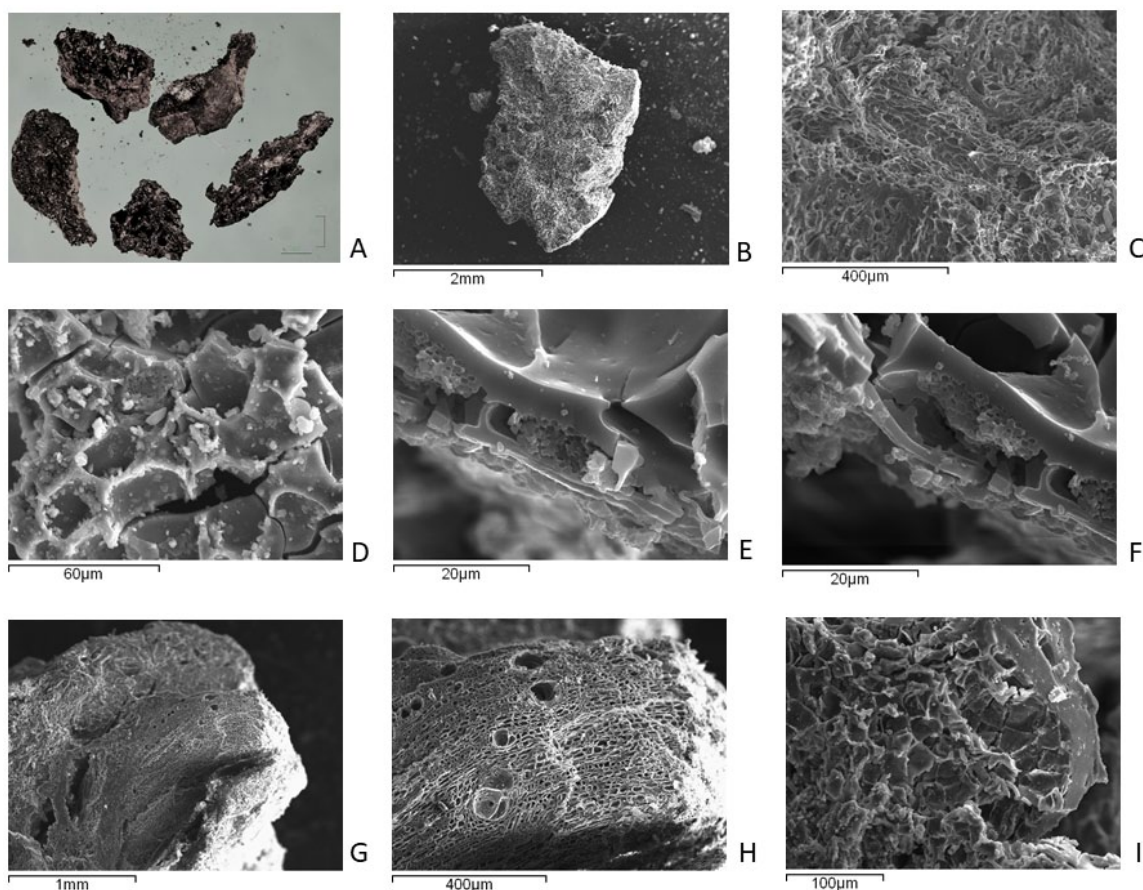


Fig. 16. Microphotographs of the food remains from Vaskovo: A. Macroscopic overview of possible food fragments under low magnification binocular, scale 1mm (after Valamoti et al. 2019, 108, fig. 18a); B. Macroscopic overview of a food fragment under SEM; C. Closer view of the porous structure of a fragment; D. Traces of aleurone layer; E. Preserved single layered aleurone; F. Preserved single layered aleurone (after Valamoti et al. 108, fig. 18e); G. Fragment, showing charcoal embedded in the food remain; H. Closer view of the charcoal structure; I. Another part of the same fragment shown in G and H, but the visible structure does not display any identifiable features (photos B–E, G–I by L. Papadopoulou, I. Hristova)

Обр. 16. Микрофотографии на останките от храни от Васково: А. Общ изглед на предполагаеми фрагменти от храна при ниско увеличение (под бинокулар), мащаб 1 mm (по Valamoti et al. 2019, 108, fig. 18a); В. Общ изглед на фрагмент от храната под SEM; С. По-близък план на порестата структура на фрагмент; D. Следи от алеуранов слой; E. Запазен еднослоен алеуран; F. Запазен еднослоен алеуран (по Valamoti et al., 108, fig. 18e); G. Фрагмент, показващ овъглена дървесина, запечатана в храната; H. По-близък план на структурата на овъглената дървесина; I. Друга част на същия фрагмент, показан в G и H, но видимата структура не притежава идентифицируеми характеристики (снимки B–E, G–I, Л. Пападополу, И. Христова)

similar to the one observed in the samples from Ada Tepe. The preserved interface between transversal and longitudinal cells although resembling to barley is quite problematic for definite identification (fig. 15.D, E, F). Additionally, the traces of aleurone layers show more than one row (fig. 15.G, H, I) which corresponds to barley. Based on that it could be assumed that barley is one of the components of the preserved food remain which coincides with the archaeobotanical finding from the site. Moreover, the structure where the food remains come from is a pit containing mainly einkorn and barley.

Vaskovo

The archaeobotanical information for the site comes from twelve samples taken within the studied house: from the interior of the fireplace as well as the area around it.

The main components among the studied plant assemblages are again the cereal crops, mainly hulled barley (*Hordeum vulgare* var. *vulgare*), einkorn (*Triticum monococcum*) and millet (*Panicum miliaceum*), which are typical staple crops for the Early Iron Age in the region (Hristova et al. 2017). Free threshing wheat (*Triticum aestivum/ durum*) was present in the samples, but its quantity is limited. Pulses were also a part of the ancient diet and most common among them was lentil (*Lens culinaris*), accompanied by small amounts of pea (*Pisum sativum*) and bitter vetch (*Vicia ervilia*).

Very interesting is the concentration of seeds of the oil-plant gold-of-pleasure (*Camelina sativa*). This is the second Early Iron Age site in Bulgaria where this plant was found as a concentration. The other site is Bresto in Southwest Bulgaria (Athanasov et al. 2015). Apart from the above mentioned finds, during the Iron Age it was commonly found in archaeological sites in the Aegean and Western Anatolia (Riehl 1999).

Fruits were also present at the site. Seeds/fruits of grapevine (*Vitis vinifera*), fig (*Ficus carica*), Cornelian cherry (*Cornus mas*), and dewberry/ blackberry (*Rubus caesius/fruticosus*) were found.

Several very small amorphous fragments were investigated in one of the studied samples (fig.16.A). These possible food remains have a homogenous texture (fig. 16.B, C). The studied fragments are very small which made the analysis quite difficult. Despite the limitations, traces of preserved aleurone layer were observed in some of the fragments (fig. 16.D, E, F). The preserved aleurone layer is single layered which indicates the use of cereals different from barley. Comparing the archaeobotanical data from the site with the observations from the SEM analysis it could be inferred that the possible ingredients of the cereal based food remains are einkorn and/or millet.

It should be noted that after the analyses with reflected light microscope and SEM some of the fragments were identified as wood (fig. 16.G, H). The context of the studied samples, near the fireplace of the house, could explain the mixture of wood fragments with food remains and other archaeobotanical findings. But this also poses the question about how to distinguish food remains and/or cereal products from any other amorphous lumps (Heiss 2019) such as fruit flesh, very distracted wood, etc., and especially when the fragments are very small (fig. 16.I).

Discussion

Food remains in a diachronic perspective

In order to go further with the study and interpretation of the ancient food remains it is important first to examine the possible ingredients, in other words the plants that were used (grown and/or collected) by ancient communities as food. Archaeobotanical lists of species offer insights of the available ingredients while the actual food remains presented above offer a rare opportunity to obtain first-hand information on which ingredients were being mixed and processed for the preparation of food. During all the periods considered here cereals were the staple crops, but also pulses, fruits, nuts, oil plants were part of the people's diet. The most common cereals during the Neolithic and Chalcolithic periods were the hulled wheats – einkorn (*Triticum monococcum*) and emmer (*Triticum dicoccum*). Barley (*Hordeum vulgare*) has always been one of the staple crops but usually retained a secondary

role (Marinova 2007). Free threshing wheat appears sporadically during those periods, but high concentrations have been found at several Chalcolithic archaeological sites in Eastern Bulgaria, mostly along the Black Sea coast (Marinova, Valamoti, 2014, Gleser and Marinova 2018). Glume wheats continue to be predominant during the Bronze and Iron Ages in Bulgaria, but the presence of free threshing wheat increases (Popova 2009; Hristova et al. 2017; Nikov et al. 2018). Barley retains its role as a staple crop, and it is present almost in all sites as a main or a secondary cereal. Since the Late Bronze Age onwards millet (*Panicum miliaceum*) starts to be one of the major crops and its central role continues within the whole Iron Age (Stika, Heiss 2013; Hristova et al. 2017; Popov et al. 2018). Among the pulses the most common one is lentil (*Lens culinaris*), but bitter vetch (*Vicia ervilia*), pea (*Pisum sativum*), and grass pea (*Lathyrus sativus/cicera*) occur frequently.

Oil plants have been also part of the prehistoric diet. Finds of flax (*Linum usitatissimum*) have been found from the Neolithic (Dennel 1974; Marinova 2006a) onwards. Since the Early Bronze Age dragon's head (*Lallemantia iberica*) has been used in some sites like Dabene-Sarovka (Marinova, Valamoti 2014) and Drama (Gleser, Marinova 2018). *Carthamus tinctorius* appear in the Early Bronze Age in Karanovo (Marinova 2004; Marinova, Riehl 2009). And *Camelina sativa* has been discovered in the Early Iron Age sites of Bresto (Athanasov et al 2015) and Vaskovo.

When discussing the ingredients of cereal based food remains, one have to consider also other possible non-plant components that might have been added to the meal either for flavouring it (see Heiss et al. 2017) or for making it more nutritious (Valamoti 2011, Heiss et al. 2015). Animal components like milk and/or fats could also be part of the prepared meal. Condiments like salt would enhance preservation and longevity. In Bulgaria salt has been produced since the middle of the 6th millennium BC (Nikolov 2011) and is particularly connected with the studied here site Provadia-Solnitsata.

It is quite important when trying to interpret the amorphous lumps found in the archaeological samples to bear in mind that plants could also be used for the preparation of beverages (Valamoti 2018). Cereals like millet and barley could have been used in prehistoric times for beverages like boza (fermented drink on basis of millet porridge, see Hornsey 2003; Popov et al. 2016), beer or similar drinks with varying alcoholic contents (Valamoti 2009). Any other ingredients used in the preparation of bevarages should not be excluded, added as preserving agents, for flavouring or making them more palatable (Behre 1999).

Another important aspect for the interpretation of similar findings is the possible stage of preparation of the cereal based products found archaeologically: coarsely or finely ground, precooked cereals, partially prepared food, final products, etc. Taking into consideration the material presented here, it could be assumed that all Neolithic/ Chalcolithic finds of cereal based products represent either loose grain fragments or agglomerations of fragments. Our first impression is that they could correspond to products similar to modern bulgur/ trahanas or cracked wheat. It should also not be excluded that these findings represent a particular stage of processed cereals stored for later cooking. In comparison to Neolithic/ Chalcolithic finds, the food remains from the Late Bronze Age and the Early Iron Age represent porous mass with or without visible fragments and resemble more to the modern bread/porridge, dough and flour. It could be assumed that such cereal products correspond to a more thorough processing of the grains by longer grinding and introduction of new cooking practices that aimed the preparation of some form of bread/ porridge/ cake batter. They also could be a result of finished products after boiling/ baking which could have made the finely ground cereal particles to fuse together. This hypothesis is based only on the material studied here,

which is insufficient for making more general inferences. More data is needed in order to make conclusive differentiation of food preparation practices through time.

Recognizing cereal products in the archaeological record

Usually the archaeobotanical finds of food remains are represented by small fragments which makes their interpretation very difficult. However, there are exceptional finds preserved in vessels like several of the examples presented here (Kapitan Dimitriev, Karanovo, Provadia–Solnitsata, Kush Kaya). This experience shows that by careful excavation and good preservation, food remains can be uncovered *in situ* and bring unique information about food preparation practices.

Some of the food remains were found on the floor/ cultural layer, inside buildings (Ada Tepe and Vaskovo). Often such remains are more numerous near ovens or installations related to cooking – such contexts should be sampled with additional precision as they are a very important source of information regarding everyday activities and cooking practices.

Interpretation of food remains found in pits (Kapitan Andreev) is more complicated partly because the interpretation of those structures is quite controversial in the study region (Tonkova, Savatinov 2001). It is very difficult to determine whether the botanical remains found in pits belong to the primary function/ activities of the pits or to their secondary infill (Hristova et al. 2017). However, pits related to cult and ritual deserve special attention, as food objects are placed there with special care and have better chance to remain preserved (Heiss et al. 2019).

Very often in the archaeobotanical samples emerge small amorphous fragments without any preserved structure. Such remains must be identified and interpreted very cautiously as they could belong to different materials like fruit flesh, food/ beverage, wood, etc. Non-food material could become incorporated in the possible food remains (as is the case with the studied here site Vaskovo, see Results chapter) which increases the chances of misinterpretation. Very often the identification of amorphous remains requires special equipment and reference material, and if they are lacking such remains cannot be identified properly. At least a microscope with reflected light (magnification up to 400x) and even SEM (magnification up to 1200x) are needed for their proper identification. Only the use of such optical equipment would allow to observe the micro-structures on tissue or cellular level needed to determine the origin and possible taphonomy of the amorphous fragments. Apart from good microscopic equipment, a reference material of experientially charred variety of the possible food products is also needed in order to compare the microstructure of the known processing and ingredients with the archaeological food finds.

The interpretation of possible archaeological food remains is tightly connected with the taphonomic factors and the archaeological context. The archaeological context is extremely important in order to understand what kind of material could be preserved which can hint the special activities related to food processing, such as cooking, brewing, ritual meals, dumping refuses, remains of animal dung used as fuel, etc. Without the proper knowledge of the context it is very hard to distinguish whether the alteration of the material is due to cooking or due to subsequent charring (caused by accidental contact with heat) within the archaeological context.

Conclusions

The evidence for cereal food presented here does not allow definitive interpretations in terms of the intended end products. However, it was possible to recognize the plant

ingredients or at least those that had survived in the charred food masses. Some of the ingredients may not leave recognizable traces, and some may be of non-plant origin like milk, animal fat and salt that cannot be distinguished with the applied here methodology, or at least at the present state of knowledge. As discussed above, the food preparations surviving in the archaeobotanical record may represent different stages of cooking or pre-cooking of a meal (sometimes stored for piecemeal consumption) and not always the final products.

The amorphous lumps recognised in the archaeological contexts and analysed in the current paper usually contain preserved cereal pericarp and/ or aleurone layers which allows to be concluded that they are cereal based food products. The food fragments considered here derive from meals prepared by finely or coarsely ground cereals. All the cereal food remains from the Neolithic/ Chalcolithic period represent coarsely ground cereals, while the later (Late Bronze Age and Early Iron Age) ones have characteristics of finely ground cereal products.

The cereal crops prevailing at the studied sites (hulled wheats, barley and since the Late Bronze Age – millet) could be used for the preparation of porridges or flatbreads. The increase of free-threshing wheat in the Early Iron Age could point towards the introduction of new cooking/ baking techniques and suggests possible shifts in food processing practices. Findings of better preserved examples of bread-like food products, or evidence for beverage/ beer production, etc. are needed in order to obtain further insights into prehistoric cereal food preparations. Otherwise it will not be possible to define the final products and put labels like porridge, bread, bulgur/trahanas, flour, beer, etc.

The rigorous application of a robust methodology for the analysis of cereal food remains, along the lines presented in some preliminary studies (e.g. Heiss et al. 2017; 2019; Valamoti 2018; Valamoti et al. 2019) will allow to distinguish different stages of food preparation and the end-products in the future. Further studies of similar residues found at archaeological sites and in combination with other kind of analyses such as biochemical and residue analysis will give the necessary information on cereal food preparation techniques and help in the interpretation of the final products. Another important aspect is the comparison with ethnographic evidence and experimentally prepared cereal-based food, which is currently underway within the ERC project PLANTCULT.

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Разпознаване на археологически останки от храна: примери от археоботанични изследвания от България

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(резюме)

Настоящото изследване разглежда археологически останки от храни приготвени от зърнени култури. Тези находки произхождат от седем археологически обекта разположени на територията на България (Капитан Димитриево, Караново, Провадия–Солницата, Куш Кая, Капитан Андреево, Ада Тепе и Васково) и обхващат времеви диапазон от ранния неолит до ранната желязна епоха (VI хил. пр. Хр. – I хил. пр. Хр.).

Целите на настоящото изследване са да повиши информираността на проучвателите за подобен тип находки, да улесни идентифицирането им в археологическите контексти, както и да представи основните принципи за техния лабораторен анализ. Изследваните храни съответстват главно на фрагменти от зърнени култури, агломерации от подобни фрагменти или аморфни/порести структури с или без видими включения от растителни тъкани. Останките са взети директно от съдържанието на съдове или произхождат от флотационни проби, събирани от подовите нива близо до пещи или подобни отоплителни съоръжения в помещения. Микроскопската структура на хранителните останки е описана на ниво растителна тъкан, като за целта е използван биноколяр с увеличение 10х–40х, микроскоп с отразена светлина с увеличение 100х–400х и сканиращ електронен микроскоп (SEM) с увеличение до 1200х. Благодарение на тези анализи могат да бъдат наблюдавани измененията в микроструктурата на възможните останки от храни и евентуално да се стигне до разпознаване на различни технологии за приготвяне на храна.

Аморфните фрагменти, намирани в археологически контекст и анализирани в настоящото изследване, обикновено съдържат запазени части от перикарп на житни растения и/или алеуронов слой, което позволява да се заключи, че това са хранителни продукти съставени от житни култури. Разгледаните тук фрагменти произлизат от храни, приготвени от фино или грубо смлени житни зърна. Останките от периода на неолита и халколита представляват сравнително грубо смлени житни зърна, докато находките от по-късните периоди (късна бронзова и ранна желязна епоха) притежават характеристики на фино смлени зърнени култури. Анализът на последните показва въвеждането на по-разнообразни процеси и технологии за приготвяне на храна, в сравнение с по-ранните периоди.

Представените в статията материали/останки от храни не позволяват окончателно определяне на крайните продукти. Въпреки това е възможно да се разпознаят растителните съставки или поне тези, които са оцелели в овъглените хранителни маси. Идентифицираните клетъчни структури отговарят на ечемик, просо и пшеница. С цел да се постигне по-точно определяне на растителните съставки е направено сравнение със запазените археоботанични материали от съответните обекти. Трябва да се има предвид, че някои от компонентите може да не оставят разпознаваеми сле-

ди, а други може да са с нерастителен произход, като мляко, животински мазнини и сол, които не могат да се различат с прилаганата тук методология или поне не към настоящото ниво на изследвания. Хранителните продукти, оцелели в археологическия контекст, могат да отразяват различни етапи на приготвянето или предварителната подготовка на хранителните съставки (понякога съхранявани за по-нататъшна консумация) и не винаги крайните продукти.

Много често в археоботаничните проби се появяват малки аморфни фрагменти без запазена структура. Идентифицирането и тълкуването на такива останки трябва да се прави много внимателно, тъй като те могат да принадлежат към различни материали като месестата част на плод, храна/ напитки, дърво и др. Различни органични материали могат да бъдат интегрирани в евентуалните остатъци от храна (както в случая с обект Васково), което увеличава шансовете за неправилно интерпретиране.

Настоящото проучване демонстрира още, че за да се осъществи едно системно изследване на подобни останки е препоръчително внимателно вземане на проби и документиране на овъглената материя, разпознаваема в съдовете, в и около структури, които могат да бъдат свързани с ежедневната подготовка на храни (огнища и пещи), както и структури с ритуален характер. Именно прилагането на подобен подход ще позволи да се получи надеждна информация за приготвянето и консумацията на храни в миналото.