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LOOKING THROUGH HUMAN EATING IN PREHISTORIC AND PROTOHISTORIC CAMPANIA: BIO-ARCHAEOLOGICAL REMAINS OF A CEREAL SOUP COOKED IN A TURTLE CARAPACE FROM ACERRA (NA), SOUTHERN ITALY

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Abstract. During of the archaeological excavation campaign of June 2018, in the course of the construction works of the Naples - Bari High-Speed Rail Line (route to the Napoli-Cancello section) in Acerra (NA) a silo and a combustion pit were found inside an abandoned village of the Eneolithic age with abundant carpological remains. In the same area, but dating back to the Middle Bronze Age II, some fragments were found of osteological burnt animal bones, coming from the sieving of the filling of a pit of the Bronze Age; among them a *unicum*, consisting of a fragment of burned costal plaque, belonging to a Testudo hermanni, to which charred remains were stuck, composed of some caryopses of medium spelled (*Triticum dicoccum*), fragmentary caryopses of barley (*Hordeum vulgare*) and lumps of agglutinated organic substance. This discovery made it possible to reconstruct the fragment of a pot with residues of a cereal-based soup. Furthermore, dating to the Early Bronze Age II, two fragments of whole-meal bread rich in bran and cereal seeds were also found.

1. Introduction

The archaeological investigations conducted in the Acerra (NA) area on the occasion of the construction of the Naples-Bari High-Speed Rail Line, (route to the Napoli-Cancello) allowed the recovery of bio-archaeological, prehistoric and protohistoric remains within a context relating to the Eneolithic Age, 2150 BCE, (De Vita *et al.* 1999), Early Bronze Age II 1995 BCE (Sevink *et al.* 2011); 1900 BCE (Bini *et al.* 2019); 2040 − 1740 BCE (Calderoni, Cazzella, and Preite Martinez 2012) and Middle Bronze Age II between 1500 and 1600 BCE, (Cocchi Genick *et al.* 1995). These are the ages but what we would like to stress is the exceptional relevance of such remains within the European scientific panorama. The Acerra territory occupies a flat area of about 55 km^2 in the northeast of the Neapolitan hinterland, (Fig. 1), about 14 Km^2 north-east of Naples, with an altitude of approximately 28 m above sea level (coordinates 40° 57’ N / 14° 22’ E).

FIGURE 1. The site of Acerra is located north of Mount Vesuvius on the Campania Plain in Southern Italy.

Archaeobotanical studies have documented both the cultivation of cereals and the associated and indispensable roasting practices ever since the prehistoric period. Since prehistoric times the cultivation of dressed cereals and the associated roasting process using heat were in use, the latter being indispensable both for the use of the seeds for food and for preservation. In fact, the roasting of cereal ears had several purposes: it inhibited parasitic attack, prevented seed germination, favored preservation by blocking starch fermentation, and dehydrated the glumeal envelopes (particularly leathery and adherent in ancestral species), thus facilitating the decortication of the kernels during threshing and improving the organoleptic-characteristics.

The discovery of copious carpological remains of cereals have made it possible to hypothesize the manifestation of an agricultural ritual relating to the abandonment of a village of the Eneolithic age. In the same area, but found on the paleo-soil of Ancient Bronze II, two charred vegetal remains were recovered traceable to whole wheat bread crumbs. During the archaeological excavation of a well dating back to the Middle Bronze Age II a unicum was found consisting of a fragment of a pot made with a tortoise carapace with the charred residues of a cereal-based soup; the archeo-zoological fragment was evidence of one of the methods of preparation and cooking of food during the Bronze Age.

2. Materials, methods and results

The bio-archaeological materials analyzed consist of charred plant macro-remains and faunal remains from three stratigraphic levels with different dating. Their recovery occurred during archaeological excavations (Marzocchella 1998) using stratigraphic methodology (Bahn and Renfrew 2009); the earthy stratigraphic units that contained the treated material were processed in special areas set up near the excavation site with different methodologies

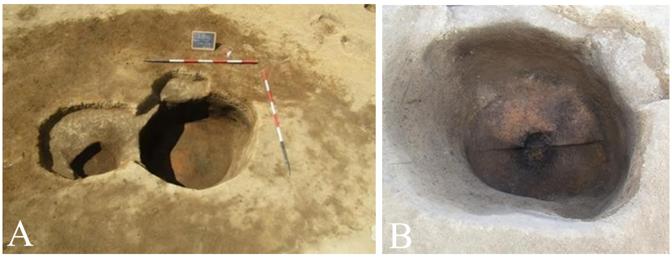

FIGURE 2. A) Silo pit being excavated; B) Silo pit under excavation.

(flotation in water and dry sieving). In some cases, laboratory analyzes were carried out, such as isotopic, mineralogical-petrographic analyzes and observations under a 150X biological microscope. The analyzed remains consist of:

- Carpological remains consisting exclusively of caryopses of dressed cereals, stratigraphically dating to the Eneolithic, coming from a silo for the storage of cereals, and from a roasting pit for the practice of roasting. Four samples of charred seeds were taken from the silo (approximately 100 seeds per sample) for isotopic analyzes in order to better characterize the seeds. Furthermore, 2 earthy samples (approx. 250 g) relating to its cover and the bottom were taken for mineralogical-petrographic analyzes in order to characterize the earthy sediments used for its construction. In the same way, 4 samples of charred seeds were taken from the roasting pit (approximately 200 seeds per sample) for isotopic analysis and 2 earthy samples (approximately 400 g) were taken from the level near the bottom of the pit and on the bottom itself for mineralogical-petrographic analyses.
- Charred plant macro-remains from the paleo-soil, stratigraphically dating to the Early Bronze II. They consist of 2 samples of carbonized, amorphous and agglutinated organic substance analyzed under a 150x biological microscope (awaiting SEM-EDS analysis) for the purpose of their determination.
- Archaeo-faunal remains coming from a well stratigraphically dated to the Middle Bronze II observed under a 150x biological microscope (awaiting analyses SEM-EDS) consisting of a fragment of proximal radial epiphysis belonging to the taxon Bos taurus, with cutmark, as well as a rib plate of Testudo hermanni, interpreted as the fragment of a container/pot with residues of a cereal soup on the surface.

Detailed reports and photographs for each point covered as follows:

2.1. Eneolithic Age. Within an abandoned Copper Age village, at an advanced stage of the Laterza facies, two relevant carpal assemblages, consisting of cereals, were recovered in phase with each other and preserved respectively within two substructures: the first one was a *silo* (Fig. 2) (max. Ø ca. 1,40 m, depth ca. 1,50 m) that yielded ca. 1,6 kg of emmer *(Triticum dicoccum*) caryopsis stripped of their glumeal envelopes and ready for consumption (Fig. 3). The second a roasting pit (Fig. 4) (2,50 × 2,15 m, depth 0,60 m) containing ca. 4,3 kg of caryopses and dressed consisting approximately in equal parts of emmer (*Triticum dicoccum*) and common barley (*Hordeum vulgare*), for which the average biometric indices per 100 caryopses were calculated (Table 1) (Fig. 5).

FIGURE 3. A) Caryopsis coming from *silo*; B) Detail: emmer caryopsis.

FIGURE 4. Cereal *roasting* pit being excavated.

TABLE 1. *Roasting pit* biometric index on a sample of 100 seeds: 50 *Triticum dicoccum* / 50 *Hordeum vulgare*

SPECIES	Lu	La	Sp	Lu/La	Lu/Sp	La/Sp	values
T.dicoccum	6,84	3,88	2,80	1,76	2,44	1,38	**medium**
T.dicoccum	7,43	4,43	3,22	1,67	2,30	1,37	**maximum**
T.dicoccum	5,35	2,34	2,06	2,28	2,59	1,13	**minimum**
H.vulgare	6,57	4,42	3,00	1,48	2,19	1,47	**maximum**
H.vulgare	6,00	3,22	2,48	1,86	2,41	1,29	**medium**
H.vulgare	**5,02**	**3,03**	**2,01**	**1,65**	**2,49**	**1,50**	**minimum**

The quantity of charred seeds found would suggest a ritual of propitiatory abandonment of the village or at least a manifestation of voluntary acts rather than a double human error in fire management. In fact, this preliminary paper is meant as leading to a wider study of the manifestations of ritual vegetable offerings (Grifoni Cremonesi 2015) to be included in the panorama of European prehistory. On the one hand, the territory of Acerra, within

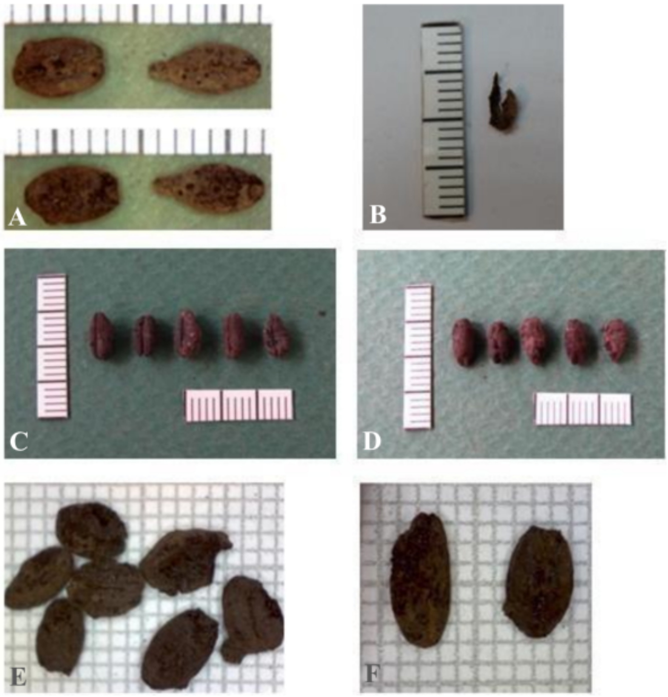

FIGURE 5. *Roasting pit* cereals: A) *Hordeum vulgare*, *Triticum dicoccum*; B) Barley glume; C) Cereal caryopsis's ventral view; D) Cereal caryopsis's dorsal view; E) Observations under a biological microscope; F) Detail: *T. dicoccum* and *H. vulgare*.

the Campania plain, enjoyed the fertility of the soil thanks to the minerals present in the stratigraphic sequence of volcanic deposits Somma-Vesuvius and Caldera of Campi Flegrei (Nava *et al.* 2007; Laforgia and Boenzi 2011). On the other hand, it was certainly subjected to the floods of the great river Clanio documented in historical age (Caporale 1856). In fact, although it was a vital resource for nature and man, it is not possible to rule out floods which might also explain the abandonment of territories. This preliminary hypothesis is based on the fact that in ancient historical times the countryside of Acerra, Aversa and Atella, were systematically flooded by Clanio and tended to stagnate near Liternum, in the area of Lake Patria, as it is known today (not by chance called "Lagno"). In fact, important hydraulic works had been prepared since 1539 while between 1610 and 1616 the project of the network of canalizations of the Regi Lagni was implemented by the architect Domenico Fontana (Strazzullo 2006).

Archaeometric analyses of stable isotopes as for Report 1 were carried out by Prof. C. Lubritto (Department of Environmental Sciences and Technologies - University of Campania Luigi Vanvitelli) on 8 seeds samples of which: 4 from the silo-pit and 4 from the roasting pit. The 4 samples relating to the silo are numbered from 1 to 4, consist of approximately 100 seeds each and were taken every 37,5 cm (moving down from the top to the bottom).

The 4 samples relating to the roasting pit are numbered from 5 to 8, they are made up of approximately 200 seeds each taken every 15 cm (moving down from the top to the bottom). They confirmed the bio-archaeological record. In fact, both sample no. 1 relative to the top of the silo, and sample no. 8 relative to the bottom of the roasting pit, present a higher percentage of the nitrogen isotope 15 (^{15}N), which can be explained by a greater presence of the organic component probably due to external contamination. While, for the seed assemblage present in samples no. 2 (silo II level) no. 3 (silo level III), no. 5 (roasting pit level I), it is possible to hypothesise the ancient use of organic fertiliser. Thin section petrographic analyses were also carried out by Dr. S. Bravi and Dr. C. Rispoli (Department of Earth Sciences, Environment, Resources - University of Naples Federico II) in order to characterise the mineralogical component of the relative stratigraphic units, as per Report 2; a total of 4 earthy samples of approximately 250 g each were taken, of which 2 came from the silo (samples no. 1 cover and no. 2 bottom) and 2 samples were taken from the roasting pit (sample no.3 at approximately 45 cm upper level above the bottom and no.4 bottom of the pit). These analyzes made it possible to confirm the mineralogical composition of the paleo-soils, consisting mainly of successive tephra deposits and anthropic actions like the use of clayey sediments and use of fire (Sulpizio *et al.* 2008).

Report 1: Isotopic mass spectrometry results

Eight samples were examined, of which 4 came from the roasting pit and 4 from the silo. Chemical pre-treatments of all samples, for the extraction of the organic part by way of acid-alkali-acid (AAA) protocol (Mook and Streurman, 1983), were carried out in the iCONa Lab of the Department of Environmental, Biological and Pharmaceutical Sciences and Technologies of the University of Campania 'Luigi Vanvitelli'. Stable isotope measurements and C and N concentrations were carried out, at the same iCONa lab, by a Thermo Fisher Flash EA 1112 elemental analyzer coupled to a Thermo Delta V Advantage isotope ratio mass spectrometer (IRMS). Samples were run against blank cups and known standards. Three capsules of standard were analyzed at the beginning of each sequence and one every six samples as a quality control measure and to compensate for potential machine drift. Experimental precision (based on the standard deviation of replicates of the internal standard) was $< 0,2$ ‰ for $\delta^{15}N$ and $< 0,1$‰ for $\delta^{13}C$. International IAEA reference standards were used to calibrate samples measurements. The $\delta^{15}N$ and$\delta^{13}C$ values were obtained in parts per thousand (‰) relative to Vienna Pee Dee Belemnite (VPDB) and atmospheric N_2 standards respectively, according to the following formula:

$$\delta^{13}C \text{ or } \delta^{15}N = [R_{sample}/R_{standard} - 1] \times 10^3\,, \tag{1}$$

where $R = ^{13}C/^{12}C$ or $^{15}N/^{14}N$.

The results of the measurements are shown in Table 2 below. The carbon isotope ratios show a homogeneity of values and confirm the C3 nature of many of the finds analyzed. The results of the nitrogen isotopic values are, on the other hand, much more variable, reflecting the different modes and sources of nitrogen uptake by each of the types of vegetation analyzed.

Report 2: Thin Section Sample Observations. The samples provided consisted of four bags containing loose earthy materials and loosely compacted fragments. Two bags from the silo (no. 1, no. 2) and two from the roasting pit (no. 3, no. 4) (Figs. 6 and 7).

TABLE 2. δ^{13}C, δ^{15}N isotopic ratio and concentration of C and N for each sample.

Sample	**Level**	**Taxa**	**δ^{13}C (‰) vs. VPDB**	**δ^{15}N (‰) vs. Air**	**%N**	**%C**
1	The Silos Level	*T. dicoccum*	$-23,5$	10,0	2,5	58,7
2	II level Silos	*T. dicoccum*	$-22,5$	3,0	2,0	61,8
3	Level III Silos	*T. dicoccum*	$-22,8$	6,6	2,3	64,3
4	IV level Silos	*T. dicoccum*	$-22,8$	2,6	1,7	61,5
5	The Pit Level	*H. vulgare*	$-23,4$	4,0	2,5	65,7
6	II level Pit	*H. vulgare*	$-23,4$	3,6	1,5	67,1
7	Level III Pit	*H. vulgare*	$-23,9$	1,3	1,2	63,7
8	Pit Fund	*H. vulgare*	$-22,4$	5,5	2,6	62,7

The preparation of thin sections, four in number (one per sample) required epoxy resin embedding of the above materials.

FIGURE 6. Silo-well. Sample 1: upper part of the silos near the cap (cover). Sample 2: silos bottom consisting of fired clay sediment.

The thin sections were examined under light microscopy, with a binocular microscope and with a mineralogical microscope (crossed Nicols), in order to determine the main lithological and mineralogical components. Acid etching tests on the samples showed the substantial absence of limestone materials.

Concerning roasting pit samples, sample no. 3 (Fig. 8), in terms of its mineralogical component, shows fragments of millimetric crystals of clinopyroxenes, alkali feldspars (cf. Sanidine/Microcline), small volcanic lithic inclusions, as well as pumices with altered margins, in a fine-grained matrix (siltyarenaceous) and small blackish clasts, opaque in thin section, probably attributable to carbonaceous material. Altered crusts/halones are frequently observed around the crystals, probably due to thermal action to which the material was subjected in the silo.

Sample 4 (Fig. 9), in thin section, plagioclase (Sanidino/Microclino) with altered margins (Fig. 9A), volcanic lithic fragments including small pumices (Fig. 9B), in a fine-grained silty-arenaceous matrix are observed.

FIGURE 7. Pit for roasting cereal seeds. Sample 3: last layer consisting of burnt earth with clay fraction and charred seed fragments. Sample 4: Pit bottom composed of concreted clay matrix sediment.

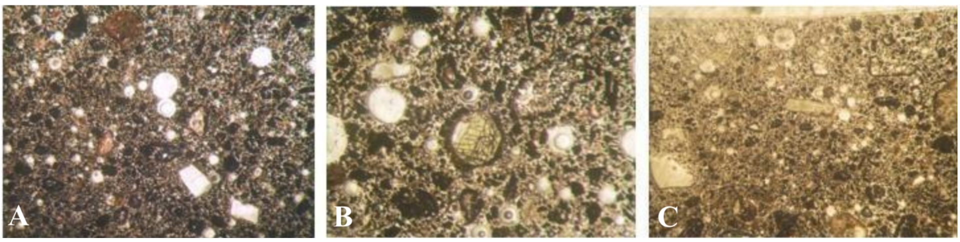

FIGURE 8. A) Overview of sample 3. Abundant black, carbonaceous clasts, clear crystals of alkali feldspars and volcanic lithic inclusions are observed; B) Detail of sample 3. A Clinopyroxene crystal with an alteration halo can be seen in the centre of the photo; C) Overview of sample 3. Abundant black, carbonaceous clasts, clear crystals of alkali feldspars, Clinopyroxene crystals with alteration halo and volcanic lithic inclusions can be observed.

Concerning silo-well samples, sample no.2 Silo Bottom (Fig. 10) in thin section: clasts between 1 and 5 mm in size are observed, consisting of volcanic pumices and lithics (including trachytic fragments), Clinopyroxene crystals and alkali feldspars (including Plagioclase). Possible presence of ceramic fragments and a probable clast of limestone origin. The matrix is reddened and, in crossed Nicols, is always extinct (glassy structure)

Silo cap (Fig. 11): in thin section, amphibole crystals, clinopyroxenes, alkaline feldspars (Sanidino), volcanic lithic fragments, plagioclase, and pumice fragments with altered margins are present. The matrix is sparse.

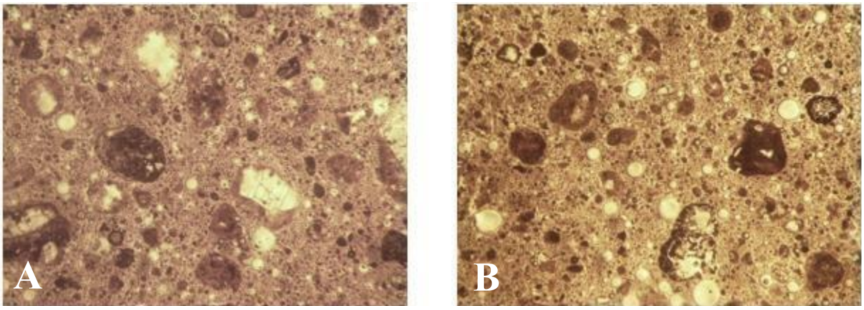

FIGURE 9. A) Sample 4. A) Plagioclase and Clinopyroxene crystals with alteration edges and lithic fragments; B) Volcanic lithic fragments and small pumices in a silty-arenaceous matrix.

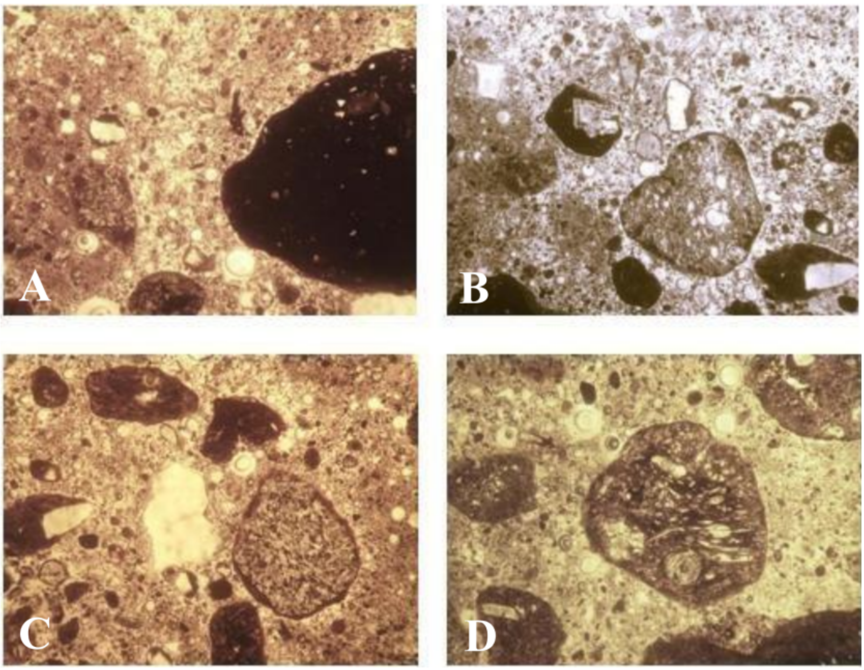

FIGURE 10. A) Silo bottom sample: pumices and volcanic lithics between 1 and 5 mm in size; B) Silo bottom: pumices and volcanic lithics with crystals included, between 1 and 5 mm in size; C) Silo bottom: alkaline and lithic volcanic feldspar crystals between 1 and 5 mm in size. On the right of the picture: a large fragment of trachytic rock; D) Silo bottom: pumices and volcanic lithics between 1 and 5 mm in size. In the centre, a pumice clast including a Clinopyroxene crystal can be observed.

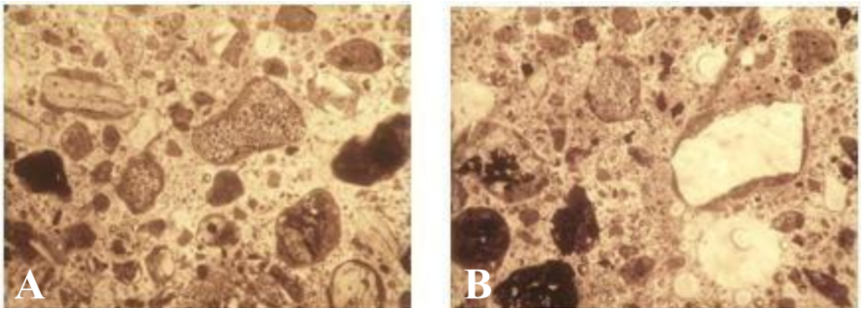

FIGURE 11. Silo cap specimen: A) Clinopyroxene and alkali feldspar crystals with altered margins. Volcanic lithic fragments; Silo cap sample: B) alkaline feldspar crystal with altered edges. Volcanic lithic fragments.

2.2. Early Bronze Age. Dating back to the Early Bronze Age II (Stanzione *et al.* 2022), other remains were recovered which are very interesting for the determination of eating habits. They consist of 2 fragments of carbonized, amorphous and agglutinated organic substance (sample B approx. 18×14×1,9 mm; sample C approx. 16×10×1,8 mm) analyzed under a 150× biological microscope. From an initial examination based on the morphology, they appear to be wholemeal bread crumbs composed of agglutinated caryopses, both whole and fragmentary (Fig.12); 'bread' is a fundamental type of foodstuff for settled communities, not only for immediate consumption but also because it could be preserved dried, like a 'wafer biscuit', easily transportable and consumed when necessary. The substance observed

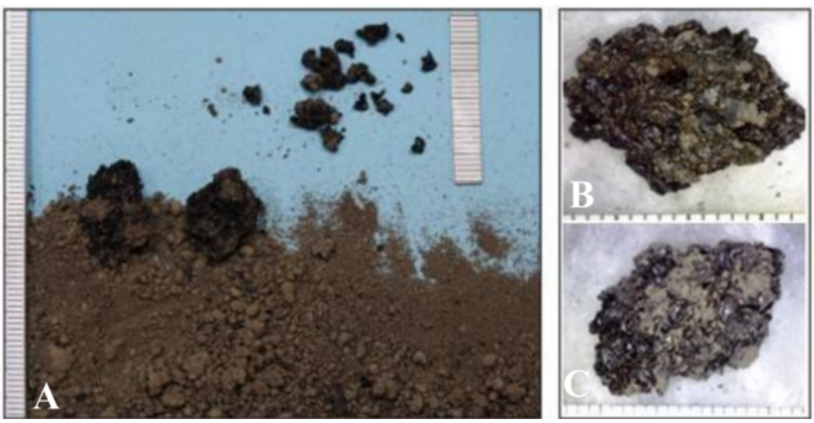

FIGURE 12. A) Dry extraction of Early Bronze Age II bio-archaeological remains; B, C) Whole-wheat bread crumbs observations under a 150× biological microscope.

is amorphous and compatible with a mixture of unrefined flour and agglutinated seeds. Future investigations using the scanning electron microscope (SEM-EDS) will make it possible to accurately analyze, without damaging the very fragile remains, the cellular patterns of the pericarp of the seeds, thus characterizing the dough (might it be composed of a single type of cereal or of different grains and/or with legumes?). Moreover, such procedure may highlight any traces of fermentation and clarify, thanks to the morphology of the starch granules, the type of cooking. In fact, they differ depending on whether the cooking took place in ovens or on stone.

2.3. Middle Bronze II Age. Dating back to the Middle Bronze Age II (Aurino 2018), some remains were recovered from the interior of a well (internal Ø ca. 3m) at a depth of ca. 1,20 (Fig. 13).

FIGURE 13. Middle Bronze II pit under excavation.

In particular, a fragment of proximal radial epiphysis of Bos taurus. It presents ca. 33 consecutive cut marks (from 1 to 2 cm in length) sequential and transversal respect to the longitudinal axis of the bone, vertically placed at the articular fossa which presuppose traces of fleshing (Binford 1981) (Fig. 14).

A notable find consists of a costal plate of *Testudo hermanni*, (ca. 7,5×4 cm) interpreted as the fragment of a pot, as on its external surface there are traces of combustion and concretions probably due to residual water, while on the internal surface burnt food residues were observed. These consisted of charred cereal caryopses within a thin layer of thickened, agglutinated and fatty charred organic substance, probably soup remains, from which it was possible to isolate 7 carpological remains, of which 4 fragments of seeds not yet determined and 2 seeds of emmer (*Triticum dicoccum*) (Fig. 15). In fact, the charred external surface and the internal surface with the presence of charred organic matter determines its use as a cooking tool. Its use as a pot leaves no doubt. It is unique for the Italian and global protohistoric age because in the literature we do find burnt parts of the turtle carapace but it is not sure whether the turtles were consumed as food or used as cooking containers. In this case it was certainly conceived as a cooking containers because of the presence of

FIGURE 14. *Bos taurus*, radial epiphyseal fragment with traces of scarnification.

FIGURE 15. Costal plate of T. hermanni with the presence of agglutinated and charred organic matter with carpological assemblage (cereal soup).

residues. In Italy in prehistoric times, there are numerous testimonies of the exploitation of chelonians, such as the Gaban Shelter in Trentino (Pedrotti 1998). For the protostoric age we have examples such as San Tommaso shelter in Enna, (Mannino, Pluciennik, and Giannitrapani 2010) Avella and Mondragone in Campania. Although there is often much discussion concerning the use of Testudines both as an integral part of the diet and as containers (pots), their use for cooking dishes is only hypothetical. The food use and intense exploitation of chelonians has widely been attested since prehistory until today (Beck and Bossard 1981; Blasco *et al.* 2016), documented in archaeological sites in various parts of the world, from Asia through Europe to the Americas but the association with food substances has never been found. To cite just a few studies relating to the discovery of chelonians, we can quote a recent article in the journal PNAS journal, (Braun *et al.* 2010) which describes the introduction of meat into the diet of ancient hominids as early as about 2 million years ago, when hominids living in the eastern regions of Africa began consuming a wide range of animals, including reptiles, such as crocodiles and turtles, although they were probably used as scavengers. The study of Neolithic populations in the Maghreb is noteworthy and comparative, attesting that the exploitation of hard materials of animal origin, in this case chelonians, was a well-established practice among the groups that occupied these areas. In fact, according to Roubet's (Roubet 1979) reconstruction, the carapace was intended to become a container for cooking; the products retrieved from the excavations in the Cappelletti cave in Algeria reveal the ability of the occupants to functionally utilise all the skeletal parts. Other notable examples can be found in Campania (Cascone 2009) and in Emilia- Romagna (Leonini *et al.* 2015). The food use of chelonians in Italy was halted in the post-war period due to the Washington Convention on International Trade in Endangered Species of Wild Fauna and Flora, Their Parts and Derivatives (CITES), approved by more than 160 countries. However, on a cultural and anthropological level, the exploitation of chelonians still takes place today in those countries where indigenous peoples have not yet completely lost their traditions. An example are the indigenous populations of the Peruvian Amazon, (Guardia 2020) who, for millennia, have been exploiting, and still do, these animals using techniques very similar to those used in the past for the preparation of sarapatera (Fig. 16), i.e. a turtle soup, which is made using the technique of disarticulating the plate and carapace and dismembering it (as also attested in medieval times in the research of Castel di Pietra) and then different ingredients are added, depending on the area, and finally cooked in the same carapace over a wood fire.

FIGURE 16. Turtle soup today in the Peruvian Amazon.

The use of chelonians in the diet has not only been part of the diet of groups settled in the Amazon for millennia, but they have also been traded and sold in river port markets. It is therefore not surprising that organic plant material was found on a fragment of carapace that may have been used for the same cooking process as cereals. So the importance of this burnt remain lies in the fact that it was found in association with a food substance and therefore attributable to its use as a fire tool for cooking food.

3. Conclusions

The preliminary bioarchaeological investigations presented in this paper, pending the full study of the area based on archaeological data (work in progress) has highlighted the use, the manipulation and cooking of plant and animal resources by prehistoric and protohistoric communities in Campania, thus underlining not only the importance of dressed cereals, indispensable sources of macro and micronutrients, but above all the technical ingenuity of man to optimize their quality, to improve their flavor and promote conservation through roasting practices (roasting pit) and storage (silo), not to mention the preparation of dry food, such as wholemeal bread. Moreover, it has made it possible to hypothesize, while awaiting the next insights, a probable propitiatory ritual of abandonment of an Eneolithic village through offerings of a plant type. Future studies will also consider how the prehistoric communities who settled within the plain of Campania benefited from fertile soil rich in minerals (thanks to the stratigraphic sequence of volcanic deposits Somma-Vesuvius and Caldera of Campi Flegrei) and from the abundance of water thanks to the presence of the great river Clanio. But it was not just all benefits. They were certainly also subjected to flooding (documented in historical times), which obviously influenced territorial occupation (seasonal settlements?). Finally, the attestation of a unicum such as the correlation between the pot and its contents (soup consisting of cereals) offers further data for studies on the daily-life activities of prehistoric communities.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests nor any personal relationships that might have appeared to influence the work reported in this paper.

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