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AN ANALYTICAL FRAMEWORK FOR THE SELECTION AND CLASSIFICATION OF ARCHAEOLOGICAL POTTERY IN ORDER TO CREATE AN INTEGRATED CHARACTERISTICS RECORD. I. PRELIMINARY FIELD ANALYSIS OF THE CUCUTENI POTTERY FROM HOISEŞTI (IAŞI COUNTY)

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Abstract

The present paper aims to establish a series of characteristics, as well as a theoretical and methodological framework, to help assess the possible utility of Neolithic pots, based on the analysis of its fabric. Our approach is based on the use of a series of analytical parameters, through the use of macroscopic or microscopic visual inspection of pottery fragments on site. The variables identifiable through this analysis help us define the physical characteristics of the fabric, firing and non-plastic inclusions. By applying the methodology of this study to the Cucuteni A pottery from the Hoiseşti – the La Pod site, we were able to define three categories of fabrics, each with its specific characteristics and possible utilities. This approach helped us determine the possible site function during its excavation and record the characteristics of the pottery in an integrated table.

Keywords: *pottery; Cucuteni; visual analysis; physical analysis; structural analysis.*

Introduction

The Cucuteni settlement in the Hoiseşti village (Dumeşti, Iasi County) was discovered in 1988. Surface researches were carried out in 1989-1991 and the results were partially published [1].

The settlement in Hoiseşti (Fig. 1) is located in a bend on the left side of the Bahlui river, in front of the bridge which connects the village Hoiseşti, with the European Road 587 Iaşi - Roman (19 km from Iasi the D.C. 36A forks to Hoiseşti). It is a lowland settlement, in the major riverbed of Bahlui, at about 500 m north of its contact with the hill connected to Valea Sărăturii, a right tributary of the Bahlui River. In terms of stratigraphy, three levels of inhabitation belonging to Cucuteni phase A3 were identified; there were also identified Cucuteni B pottery fragments, but not associated with any archaeological feature. The settlement was affected by the erosion of the river banks, by various military works during World War II, by civil works, but especially by the recent regularization of the river course, by the excavation of a deviation channel and the construction of a concrete bridge [2, 3].

The present paper represents a first part in a series which will aim to establish criteria for the evaluation of prehistoric pottery, recorded in an integrated list both for historical purposes and for museums.

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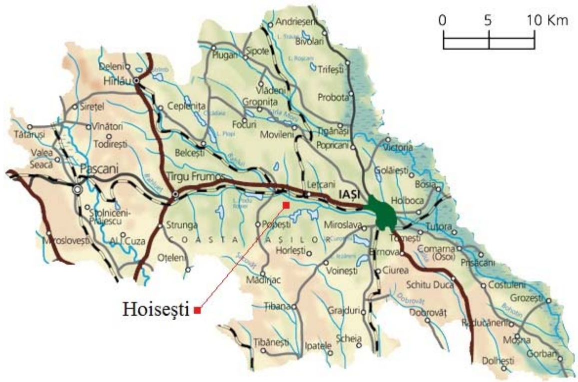

Fig. 11. Hoiseşti – *La Pod*. Geographic location in Iasi county.

We analyzed a sample of 50 pottery fragments from the settlement of Hoiseşti. They were chosen to represent a relatively equal number from the three categories of pottery : fine, semi-fine and coarse. Due to the destructive methods used in this study (e.g. study of fresh fracture, testing with hydrochloric acid solution, grinding to test magnetic stimulus-response), pottery fragments were chosen from uncertain stratigraphic situations. We obtained interpretable results from only 43 pieces. Seven samples were compromised by inadequate treatment during primary processing. Out of the 43 pieces, 15 were fine, 14 semi-fine and 14 coarse pottery (for a detailed descriptions of the results see table no. 1). We intend to further develop our approach through currently available specific laboratory procedures [4] so as to both verify and improve the obtained datasets.

Materials and Methods

Our study, with adaptations imposed by the characteristics of the subject, focuses on the fundamental methodological principles used in the study of archaeological pottery fragments [5]. From the many analytical approaches presently known, we decided to use the visual inspection of ceramic fragments with simple optical instruments (magnifying glass, binocular microscope) together with a series of simple operations, easily implemented in the field. The variables identified by this method consist in defining the physical features of the pottery, the firing characteristics and non-plastic inclusions, which allow the definition and classification of various fabric types.

a. Appearance

A useful criterion in determining the type of fabric is determined by the tactile inspection of the surface texture. The three identifiable differential criteria are abrasive (abrasive to touch), rough (irregularities are felt) and fine (when the surface is smooth) [5].

b. Hardness

Normally, material hardness is measured according to the Mohs scale. In the absence of specific logistics due to field conditions, we evaluated hardness by assessing the mark left by the attempt of scratching the surface with the fingernail or with a nail or knife. We determined three levels of gradation: **low**, **medium** and **high**. Thus, ceramic fragments with low hardness have a surface that can be scratched with a fingernail; medium hardness presents a surface that cannot be scratched with a fingernail, while high hardness cannot be scratched with a knife [5].

c. Density

To determine fabric density we analyzed the structure of a fresh crack [5]. In the case of Cucuteni pottery we determined four types of density. The first type consisted of a fine section, with flat or slightly curved surface, without visible irregularities or with small irregularities placed close one to another. The second was defined by irregular fractures, with larger irregularities, more distant from each other. The third was determined by disorganized fractures presenting large irregularities, generally with an angular shape. The last criterion was defined by laminated fractures, with a scalar aspect.

d. Firing characteristics

To determine the firing characteristics we analyzed the layer color of a fresh vessel section in five areas [5].

The first area was the core. That part of the vessel, the least exposed to the furnace atmosphere, was not exposed to extreme temperatures. Vessels with a black or dark gray core may contain carbon resulted from incomplete combustion of the organic material of the pot. As the carbon is burned, oxygen is consumed, leading to local reduction of raw material. Hence the gray or black color of the core. As the burning continues, the oxygen in the furnace atmosphere may oxidize the core, leading to a brown or red color.

The next areas are the borders of the core - the area between the core and the surface of the pot. The absence of color differences between the core and its borders may indicate either that the burning was strong and long enough, or (in the case of gray or black fabric) that it was rather short. If the outer border has a different color than the inner one than the mouth of the pot may have been covered in a certain manner during the firing process.

Finally, the color of the surfaces (inside and outside) of the pot were analyzed. The existence of differences in color between the surfaces and borders may indicate a rapid change of combustion conditions, such as opening the oven while the pottery was still hot, a strong excess of oxygen, reddening the surface of the pot.

e. Inclusions

Inclusions are any visible large elements within the pot's fabric, even gaps. Sometimes it is impossible to determine whether the inclusions present in the fabric were the result of natural processes or deliberately added by the potter. The use of the term *degreaser* implies that inclusions of a specific type are artificial additions [5].

In terms of pottery, we can distinguish at least two types of clay used: primary clay, which can be found in the place where it was formed - coarse, mixed with residues of primary rock - and secondary clay, which underwent a transportation process and was naturally decanted.

The last one are fine-grained clays with a homogeneous structure. Most natural clays contain other materials in addition to clay minerals. Those non-plastic inclusions can be formed, in primary clay by partially broken fragments of bedrock. In sedimentary clays, a wider range of materials can be found. Each of them may be from a different process of erosion. One of the most common materials is the rounded particle of quartz (sand) [6].

A second source of non-plastic inclusions in clay is the potter's deliberate intervention. In some cases, they consist of elements not naturally occurring in clay. In general, the degreaser added is different from the non-plastic natural inclusions and, therefore, it may easily be distinguished.

The special attention we pay to fabric inclusions is justified by the fact that in many cases they are the most reliable method to distinguish among different types of fabric. At the same time, the type, frequency, size and degree of sorting thereof are indicators of the degree of specialization of the pottery manufacturing process and the possible function of the pot. The type of inclusions can be determined using a simple key, such as that published by Peacock in 1977 [7].

For the analysis and interpretation of inclusions we used four textural parameters. Thus, in estimating the *frequency* of inclusions it is preferable to use a percentage system based on visual reporting of a set of graphs. Due to their inaccessibility and low spread, an alternative empirical system should be used, based on counting of granules visible by microscope at an adequate magnification.

Media, or more specifically the *modal* of the inclusions sizes, which expresses their overall size, can be determined easily, either by naked eye or by using a scale on the microscope, especially if aimed at specific intervals (e.g. 0.25 - 0.5 mm). This variable helps to establish the presence or absence of clay levigation as part of the processing of clay pottery, or it may be an indication of the source of raw material used by the potter.

Sorting refers to inclusions of different size categories; this parameter is an indicator of the homogeneity of the fabric.

The form of inclusions reflects the erosion history. In general, the longer this history is, the rounder the inclusions are. This is an important factor in determining the source and type of clay used and the characteristics of the resulting pottery item.

Because there are certain terms that are either not used in Romanian archaeological literature, or can be confusing due to their apparently identical meaning, we will present a brief glossary of the operative terms used in this paper.

Thus, we call *clay/clays* the raw material used in pottery manufacture in its natural state, unaltered by the intervention of the potter. *The matrix* is the clay altered by the potter's addition of degreaser, the grinding, molding and firing of the clay.

By hardness of pottery we mean the matrix' ability to withstand the mechanical stress, either by breakage or compression, before the occurrence of an event (cracking, crumbling, disintegration) that impaired the functionality of the pot. By strength we mean its ability to withstand cyclic thermal shocks before the occurrence of an event that disables the pot.

To determine whether there is some relation between the thickness of a pottery fragment and the type to which it belongs, we calculated, for each category (fine, semi-fine and coarse) the standard deviation. This value represents the variation from the average value within the analyzed group [8].

Results and Discussions

Fine pottery

a. Structural features

In the case of the Hoiseşti settlement, fine pottery is characterized by low or medium hardness, fine texture and high density expressed by fine or irregular wall section aspect. The thickness of the pottery fragments belonging to this category varies from 4.5 to 9.6 mm, with an average of 6.89 mm and a standard deviation of 1.58 mm. The inclusions are below 5% and have a maximum size of 0.1 mm, very good sorting, round or semi round shape. The most common inclusions are composed of very small quartz particles, below 0.02 mm, but there also are rock fragments of different colors. In regard to firing, all analyzed pottery fragments have undergone complete firing, their colors being almost entirely brick-red, in some cases with shade variations occurring between the interior and exterior surfaces.

b. Mechanical and physical properties

As a result of the analysis of the structural characteristics of fine pottery, we concluded that it was manufactured from homogeneous high-quality clay, with fine grain and sporadic small inclusions. During the firing process, at relatively high temperatures, the clay structure for this type of fabric showed an isotropic thermal expansion, which increased the size and density of the particles [9]. The resulting matrix is characterized by a fine-grained and homogeneous structure, relatively free of defects. Given that for ceramic materials, defects can occur either within the particles or at their boundaries, to determine the mechanical and physical properties of this type of matrix, two factors should be taken into account. Most often, defects occur at the bond between the particles and their maximum propagation is the equivalent of the particle diameter, the dislocation processes being blocked by the bonds between particles. There is also an intrinsic direct relationship between the raw material particle size and the size of possible defects within the particles, so the smaller the particle is, the lower the possibility of the occurrence or spread of a defect inside it.

Thus, pottery made from such a matrix provides a greater resistance to fracture [10-12]. At the same time, subjecting a ceramic object to a fast change in temperature will lead to differential dimensional changes in different parts of it, resulting in an accumulation of stress and, therefore, the energy of the system's pressure increases. If this tension is not very high, the existing faults will not extend and the solid item will not be affected by the thermal shock. Because pressure's energy is finite, the faults will extend only until the pressure's energy is converted into surface energy, at which point it will stop. The dimensions to which fractures may extend depend on their initial size and density. In this case, where few cracks of small dimensions are present in the original matrix, their final size will be large, resulting in a high degradation of the matrix hardness [10, 11]. We can therefore conclude that the fine pottery fabric is characterized by high hardness and low resistance to thermal shock.

Semi-fine pottery

a. Structural features

The semi-fine pottery category from Hoiseşti is characterized by low or medium hardness, fine or coarse texture and lower density, compared to the fine category, with an exclusive irregular aspect of the fresh wall section. The thickness of the pottery fragments in this category varies between 5.3 and 16.1 mm, with an average of 9.84 mm and 3.07 mm standard deviation. The frequency of inclusions is higher than in fine pottery, the percentage value ranging usually between 5 an 10%. Inclusions sorting is generally very good or good, less than 0.1 mm in size, with a round or almost round shape. In some cases a weak sorting of inclusions was observed, with diameters up to 0.2 mm and various shapes. The most common types of inclusions are fragments of quartz or quartzite, iron or black ferromagnetic ore, fragments of different rock types, of different colors and also chamotte and limestone or oolitic limestone fragments. In regard to the firing, all ceramic fragments we analyzed have undergone complete firing, their colors being either entirely brick-red or shade variations thereof, occurring between the inner and outer surfaces.

b. Mechanical and physical properties

The specific fabric of this ceramic category is characterized by the use of a homogeneous clay with a relatively high percentage of inclusions. In terms of matrix properties, it is similar to fine pottery, characterized by high hardness and low resistance to thermal shock, but of a lower quality.

Coarse pottery

a. Structural features

The coarse pottery is characterized by small to medium hardness, coarse texture and lower density than fine or semi-fine pottery, with a disorganized fresh wall section aspect. The thickness of the pottery fragments in this category varies between 7.61 and 14.92 mm, with an average of 10.52 mm and a standard deviation of 2.12 mm. The frequency of inclusions is higher than in the first two ceramic categories, with values ranging between 5 and 10% and 10 to 20%. Inclusions sorting ranges from satisfactory to very low, with variable shapes. The prevailing inclusions are angular. Their dimensions usually range between 0.15 and 0.2 mm, but there are cases where they reach 0.3 and 0.4 mm. The most common types of inclusions consist of fragments of quartz or quartzite, rock fragments of various colors and iron or black ferromagnetic ore. A single case (Table 1, sample 43) revealed intentional addition of degreaser, consisting of fragments of black volcanic rock fragments, with a vesicular vitreous structure, with diameters ranging between 0.2 and 4 mm. Most pottery fragments revealed incomplete firing. The fresh wall section of pottery fragments indicated that the clay used to manufacture the pottery listed in this fabric category was intentionally selected because of its heterogeneous nature or that it was not subjected to mechanical grinding and homogenization treatments as meticulous as the ones applied to fine and semi-fine pottery.

Table 1. Synthetic view on the results of the fabric analysis

No	Type	Hardness	Texture	Density	Thickness	Inclusions					Color				
						Frequency	Size	Assortment	Shape	Type	3	2	1	2a	3a
1	F	Low	Fine	smooth	7,47mm	< 5%	≤ 0,1mm	Very high	Round (> spheric shape)	Fragments of quartz / quartzite (<0.02 mm) rock fragments of different colors, especially black or reddish-brown	Brick-red				
2	F	Low	Fine	irregular	9,61mm	< 5%	0,02-0,1mm	Very high	Round (> spheric shape)	Very small fragments of quartz / quartzite (<0.02 mm); different rock types of different colors; especially white translucent, reddish brown and black.	Brick-red	Yellow brick		Brick-red	
3	F	Low	Fine	irregular	5,20mm	< 5%	< 0,1mm	Very high	Round (> spheric shape)	Very small fragments of quartz / quartzite (<0.02 mm); different rock types of different colors especially white translucent, reddish brown and black.	Brick-red	Yellow brick		Brick-red	
4	F	medium	Fine	irregular	7,53mm	< 5%	< 0,1mm	Very high	Round (> spheric shape)	Very small fragments of quartz / quartzite (<0.02 mm); different rock types of different colors especially white translucent, reddish brown and black.	Brick-red	Brown brick		Brick-red	
5	F	medium	Fine	smooth	5,97mm	< 5%	< 0,1mm	Very high	Round (> spheric shape)	Very small fragments of quartz / quartzite (<0.02 mm); different rock types of different colors especially white translucent, reddish brown and black.	Brick-red				
6	F	Low	Fine	smooth	8,44mm	< 5%	< 0,1mm	Very high	Round (> spheric shape)	Very small fragments of quartz / quartzite (<0.02 mm); different rock types of different colors especially white translucent, reddish brown and black.	brick-red				
7	S	Low	Coarse	irregular	6,57mm	< 5%	< 0,1mm	Very high	Round (> spheric shape)	Very small fragments of quartz / quartzite (<0.02 mm); different rock types of different colors especially white translucent, reddish brown and black.	Yellow brick				
8	S	Low	Coarse	irregular	5,35mm	< 5-10%	< 0,1mm	Very high	Round	Very small fragments of quartz / quartzite (<0.02 mm); different rock types of different colors especially white translucent, reddish brown and black; samples of iron ore or ferro-magnesium minerals.	Yellow brick				
9	F	Low	Coarse	smooth	6,55mm	≤ 5%	< 0,1mm	Very high	Round (> spheric shape)	Very small fragments of quartz / quartzite (<0.02 mm); different rock types of different colors especially white translucent, reddish brown and black.	Brick-red				
10	S	low -medium	Coarse	irregular	11,40mm	≤ 5%	≤ 0,2mm	High	Round (> spheric shape)	Very small fragments of quartz / quartzite (<0.02 mm); different rock types of different colors especially white translucent, reddish brown and black; iron and ferromagnetic ore (up to 0.2 mm) in black, which react to magnetic stimulation	Brick-red	Brown brick			Brick-red
11	S	Low	Coarse	irregular	9,52mm	5-10%	≤ 0,1mm	High	Round (> spheric shape)	Very small fragments of quartz / quartzite (<0.02 mm); different rock types of different colors especially white translucent, reddish brown and black; iron and ferromagnetic ore (up to 0.2 mm) in black, which react to magnetic stimulation	Brown brick				

12	S	Low	Coarse	irregular	9,20mm	≤ 10%	≤ 0,1mm	High	Round and sub-rounded (> spheric shape)	Very small fragments of quartz / quartzite (<0.02 mm); different rock types of different colors especially white translucent, reddish brown and black	Brick-red	Brown brick	Brick-red
13	G	Low	Coarse	disordered	9,75mm	5-10%	≤ 0,2mm	Satisfactory	Satisfactory	Very small fragments of quartz / quartzite (<0.02 mm); different rock types of different colors especially white translucent, reddish brown and black; relatively numerous and large inclusions of iron ore and FeMg	Brick-red		
14	F	medium	Fine	smooth	8,38mm	< 5%	< 0,1mm	Very high	Round (> spheric shape)	Very small fragments of quartz / quartzite (<0.02 mm); different rock types of different colors especially white translucent, reddish brown and black; very few iron ore or FeMg inclusions	Reddish brown	Brown	
15	S	Low	Coarse/fine	irregular	7,62mm	< 5%	< 0,1mm	High	Round (> spheric shape)	Very small fragments of quartz / quartzite (<0.02 mm); different rock types of different colors especially white translucent, reddish brown and black	Brick-red		
16	S	Low	Coarse/fine	irregular	6,05mm	≤ 10%	< 0,1mm	High	Round (> spheric shape)	Very small fragments of quartz / quartzite (<0.02 mm); different rock types of different colors especially white translucent, reddish brown and black	Brick-red		
17	F	Low	Fine	smooth	4,47mm	5-10%	< 0,1mm	High	Round (> spheric shape)	Very small fragments of quartz / quartzite (<0.02 mm); different rock types of different colors especially white translucent, reddish brown and black	Brick-red		
18	F	Low	Fine	smooth	6,66mm	≤ 5%	< 0,1mm	High	Round (> spheric shape)	Very small fragments of quartz / quartzite (<0.02 mm); different rock types of different colors especially white translucent, reddish brown and black	Brick-red	Brown brick	Brick-red
19	F	medium	Fine	irregular	4,77mm	≤ 5%	< 0,1mm	High	Round (> spheric shape)	Very small fragments of quartz / quartzite (<0.02 mm); different rock types of different colors especially white translucent, reddish brown and black	Brick-red		
20	F	Low	Fine	smooth	4,80mm	< 5%	< 0,1mm	High	Round (> spheric shape)	Very small fragments of quartz / quartzite (<0.02 mm); different rock types of different colors especially white translucent, reddish brown and black	Brick-red		
21	F	Low	Fine	smooth	7,11mm	< 5%	< 0,1mm	High	Round (> spheric shape)	Very small fragments of quartz / quartzite (<0.02 mm); different rock types of different colors especially white translucent, reddish brown and black	Brick-red		
22	S	medium	Coarse	irregular	13,72mm	< 5%	< 0,1mm	High	Round (> spheric shape)	Very small fragments of quartz / quartzite (<0.02 mm); different rock types of different colors especially white translucent, reddish brown and black	Brick-red		
23	G	Low	Coarse	disordered	11,99mm	5-10%	≤ 0,4mm	Low	Round -Angular (> spheric shape)	Very small fragments of quartz / quartzite (<0.02 mm); different rock types of different colors especially white translucent, reddish brown and black; iron ore or FeMg inclusions	Brick-red	Black	
23 bis	S	Low	Coarse	irregular	9,28mm	≤ 5%	< 0,1mm	High	Round (> spheric shape)	Very small fragments of quartz / quartzite (<0.02 mm); different rock types of different colors especially white translucent, reddish brown and black	Brick-red		

24	G	Low	Coarse	disordered	9,17mm	5-10%	< 0,2mm	Satisfactory	Round -Angular (> spheric shape)	Fe and Fe Mg or; fragments of various rocks and dolomite	Light yellow			
25	G	Low	Coarse	disordered	9,38mm	< 5%	< 0,1mm	Satisfactory	Angular –round	Fe and Fe Mg or; fragments of various rocks	Brown brick	Brown-gray /black	Black	
26	G	Low	Coarse	disordered	8,90mm	5-10%	< 0,1mm	High	Round (> spheric shape)	Fe and Fe-Mg minerals, fragments of various rocks, red iron ore	Brown-gray	Gray		
27	G	Low	Coarse	disordered	10,58mm	≤ 10%	< 0,3mm	Low	Low spheric shape, angular and sub-angular	Fe and FeMg minerals, fragments of various rocks, clay granules to 3 mm	Yellow brick	Brown	Brown-gray	
29	G	low-medium	Coarse	disordered	8,13mm	10-20%	≤0, 2mm	Very low	Angular (<spheric shape)	Fragments of rock, red iron ore	Brick-red	Black	Black with brick inserts	
30	G	low-medium	Fine	disordered	13,78mm	10-20%	≤ 0,2mm	Very low	Angular (<spheric shape)	Fragments of rock, red iron ore	Yellow brick	Gray	Black	
31	G	low-medium	Coarse	disordered	7,61mm	10-20%	≤0, 2mm	Very low	Angular (<spheric shape)	Fragments of rock, red iron ore	Black			
32	S	Low	Fine	irregular	10,96mm	5-10%	≤ 0,15mm	Low	Angular (<spheric shape)	Rock fragments (sporadic) - many pieces of iron and black ferromagnetic ore	brick-red		Yellow brick	
33	G	low-medium	Fine	disordered	8,86mm	5-10%	≤ 0,2mm	High	Sub-rounded	Fragments of rock and sporadic fragments of black iron ore	Brown brick		Brick-red	
34	S	low-medium	Coarse	irregular	11,74mm	5-10%	≤ 0,2mm	Low	Variable	Iron and black ferromagnetic ore, grains of quartz or quartzite, rock fragments, firebrick	Yellow brick			
35	S	Low	Fine	irregular	16,11mm	10-20%	≤ 0,2mm	Low	Variable	Numerous fragments of quartz or quartzite with a diameter of 0.1 mm, sometimes grouped in clusters, fragments of rock, round or oval holes with a diameter of 0.2 mm from the inclusions of limestone or oolitic limestone	Brick hard		Brick-red	
36	S	low-medium	Coarse	irregular	10,44mm	≤ 5%	< 0,1mm	Very high	Round (> spheric shape)	Fragments of rock and quartz or quartzite	Brick-red	Foxy	brick-red	
37	G	low-medium	Coarse	disordered	11,59mm	5-10%	≤ 0,2mm	Medium	Round (> spheric shape)	Fragments of rock, iron ore and quartz or quartzite	Brown-gray	Gray	Black	
38	G	low-medium	Coarse	disordered	11,87mm	5-10%	≤ 0,2mm	High	Variable	Fragments of rock, and red and black iron ore (occasionally)	Brick-red	Black and gray	Gray	Black
39	G	low-medium	Coarse	irregular	10,73mm	5-10%	≤ 0,15mm	Low – very low	Round fragments of rock (>spheric shape) - Angular clay flakes	Quartz or quartz, mica, rock fragments, occasionally black iron ore (≤ 0.02 mm), clay flakes	Brown brick	Brown	Brown brick	
41	F	Low	Fine	smooth	7,93mm	≤ 5%	< 0,1mm	Very high	Round (> spheric shape)	Rock fragments and quartz or quartzite	Brick-red		Yellowish-brown	
42	F	Low	Fine	smooth	8,47mm	< 5%	< 0,1mm	Very high	Round (> spheric shape)	Rock fragments and quartz or quartzite	Yellowish-brown	Brick-red	Yellowish-brown	
43	G	low -medium	Coarse	irregular	14,92mm	5-10%	≤ 0,4mm	Low	Angular	Fragments of volcanic rocks with glazed vesicular structure, diameters ranging from 0.2-4mm; Rock fragments and quartz or quartzite	Brick-red	Foxy	Brown-gray	

Legend: F = fine pottery, S = semi-fine pottery, G = coarse pottery *b. Mechanical and physical properties*

As noted above, the fabric of the coarse pottery is characterized by non homogeneous clay, with a high percentage of inclusions. To determine the physical and mechanical properties of the matrix resulted from the firing of this type of fabric, the specific behavior of clays and inclusions during the combustion and cooling of the ceramic artifact should be analyzed. Partial mechanical processing causes, during firing, a fast increase in the clay density of those parts of the matrix containing fine particles. Those groups of agglomerated particles, as well as the inclusions, have mechanical and thermal properties different from those of the original matrix and during the firing and cooling processes of the pottery they manifest an anisotropic behavior, with a thermal expansion different from that of the matrix.

Therefore, as a result of differences between the thermal expansion coefficient of the matrix (αm) and that of the inclusions (αi), a large amount of residual stress may develop during the cooling of the pot. Thus, the following two situations may occur: if $\alpha i < \alpha m$, the tensile stress developed can lead to formation of radial cracks within the matrix. Also, if $\alpha i > \alpha m$, the inclusion will tend to detach from the matrix and form pore-like defects [10, 11]. Thus, the resulting matrix will present a large number of defects such as cracks and/or pores. Since the hardness of pottery is determined by the initial number of defects within the matrix [10, 11, 13], coarse pottery items have a lower hardness than those belonging to the fine category. Analyzing thermal shock resistance of such a matrix, we found that if in the initial matrix reveals numerous small cracks, when applying thermal stress, each of them will manifest small amplitude extensions, so that the degradation of the matrix hardness will not reach high values. Moreover, by observing the propagation of cracks within the matrix, we saw that they can be diverted along the inter-granular weak links or may bifurcate around the granules; in both cases the result is a decrease in the existing stress from the crack tip, which slows down its propagation [10, 11]. In conclusion, despite its low hardness, the specific resulting matrix, characterized by a large number of defects, can be considered tolerant to thermal shock [10-12]. It is helpful to note that, in producing pottery with industrial application, the bricks made for the construction of furnaces are made such as to contain many defects and pores, so as to withstand severe repeated thermal cycles, without registering critical structural damage [13].

In terms of firing, coarse pottery is characterized by incomplete burning, resulting, in most cases, in color differences between core, borders, or surfaces. The incomplete firing created differences within the matrix volume, which in turn induced tensions between those parts of the matrix subjected to different firing, and consequently different degrees of density. The pressure lines thus created may limit the radial expansion of defects, directing them parallel to the walls of the pot and thereby diminishing the risk of defects that could lead to the decommissioning of the pot.

Conclusions

Taking into account the physical and thermal characteristics of each type of fabric and comparing them with a series of experimental data, we believe we can explain the choices made by the potter according to the intended function for each type of pottery.

The first aspect to be considered is the pottery resistance to degradation by friction, which occurs during everyday handling of the pot. Thus, fine pottery, characterized in particular by an increased resistance to fracture and being, in most cases, decorated with painted geometric motifs, was most probably used in domestic activities where external aspect counted (which explains the practice of decoration). This assumption can be strengthened by the properties of this type of fabric, observed experimentally. Thus, the degreaser-free clay was noted to be more resistant to wear by abrasion, involved by daily use. It was followed by the fabric containing inorganic degreaser and then by the one with organic degreaser in composition [14, 15]. In terms of heating efficiency of a liquid in a ceramic pot, we noted that the use of sand in their composition provided a superior performance to any other type of fabric. As an adjacent observation, during the experiments it was found that pots made with the addition of organic-degreaser to the fabric could not be used to boil water [16].

Pottery used for cooking needs resistance to thermal shock. As noted above, in terms of physical and mechanical properties of the fabric, thermal shock resistance is enhanced by the presence of defects within the matrix. This observation is supported by evidence obtained by experimental archeology. Thus, fine pottery without degreaser in its composition has been noted to present low tolerance to thermal shock, while the presence of any type of degreaser increases the resistance of the ceramic pot [14, 16, 17].

Thickness analysis of ceramic fragments specific for the three types of fabric also provided some results worth mentioning. Thus, fine pottery vessels have a wall thickness between 4.5 and 9.6 mm, with an average of 6.89 mm and 1.58 mm standard deviation, coarse pottery vessels have a wall thickness between 7.61 and 14.92 mm, with an average of 10.52 mm and 2.12 mm standard deviation, while for semi-fine pottery, the values are 5.3 to 16 mm, 9.84 average and 3.07 for standard deviation. The obtained values, out of which the most eloquent being the standard deviation sets, show us that both fine pottery and coarse pottery fall within restrictive manufacturing principles, these ceramic species being probably made in order to respond to well defined tasks. For semi-fine pottery, the high value of standard deviation indicates that this category covers a broader range of potential uses, due to its fabric characteristics, some of which being identical to those of the fine pottery category. The same observations are valid in terms of impact resistance of various types of fabric, where the most resistant proved to be the degreaser-free fabrics, followed by pots manufactured from fabric with sand in their composition, the least resistant being the ones with organic degreaser [14-16].

Analysis of pottery from the site of Hoiseşti proved that the three identified types of fabric correspond to clearly defined practical uses. By synthesizing the data obtained via experimental archeology, with those obtained by scientific material analysis of the mechanical and physical properties of ceramic fabric, we noted that the manufacture process of prehistoric pottery was a complex technological phenomenon that involved distinct technical manufacturing solutions adapted to the specific problems involved by the final utility of the pot. Thus, fine pottery was especially designed for high resistance to fracture and abrasion. Decorations indicated they were also meant to have an aesthetic value. Semi-fine pottery items meet the requirements of the daily household tasks, varying from transportation of various goods in thin-walled pots, to storage in thick-walled, while coarse fabric pots were adapted to the conditions imposed by cooking. From that point of view, we can state that the manufacture of pottery, at least for the settlement of Hoiseşti, reveals a complex set of technical knowledge only to be mastered by specialists.

The ceramic inventory of the Hoiseşti settlement, due to the obvious standardization of the techniques used to achieve fabrics specific to fine pottery, the overwhelming percentage of this category presence compared to semi-fine and coarse pottery, but also due to the technical solutions used for producing each fabric type, compel us to conclude that this settlement shows an incipient form of a surplus oriented, specialized production.

In order to support this hypothesis, one must also take into account the presence of abundant good quality alluvial clay and water in the vicinity of the settlement and, as the archaeo-zoological data indicates - the prevalence of the forests in the area indicates that wood resources near the settlement ensured the fuel requirements [18].

These statements also seem to be reinforced by a comparative overview of the manufacturing process of Cucuteni pottery during Phase A [19]. Nevertheless, in the analysis carried out on fragments of Cucuteni A pottery, the American researcher used a logistical base more sophisticated than that used by us, focusing on the study from a petrographic point of view of the pottery. Even though the number of samples analyzed is too small to allow a statistical approach, some observations can be made. Thus, unlike the ceramic samples from the

Cucuteni A levels of the Poduri, Văleni, Târgu Bereşti and Ghelăieşti settlements, analyzed in the quoted work, the Hoiseşti fine pottery is characterized by a complete absence of any degreaser, which ranks it as a high quality pottery, close in terms of technology to superior quality pottery specific to phases Cucuteni AB and B.

In the end, we may conclude that the analysis of pottery fabric inside an archaeological site can provide information on the function of the site, the different technological solutions used in the manufacturing of pottery, as well as on their intended function. Moreover, extending this type of study to a larger range of the Cucuteni settlements, and not only, may help create a more complex image of the Neolithic life by defining the degree of specialization involved in the production of pottery and, possibly, through the integration of palinological, archaeozoological and pedological investigations, may lead to the identification of production centers and exchange networks, and offer archaeologists a deeper insight into issues related to social and economic intra- and extra-comunitary social organization.

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