PRODUCTION OF BONE RINGS IN THE HAMANGIA SETTLEMENT OF CHEIA (ROMANIA)*

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Cuvinte-cheie: *cultura Hamangia, oase de ovicaprine, schema tehnică de transformare, reconstituirea experimentală a procedeelor*
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Rezumat: *Studiile efectuate asupra pieselor confecționate din materiale dure animaliere din cultura Hamangia (mileniul V cal BC) au acordat o atenție sporită materiilor prime exotice, precum valva* Spondylus *sau scafopodul* Antalis, *în detrimentul materiilor prime locale, cum ar fi osul. Totuși, cele din urmă ne pot furniza informații tehnologice și culturale importante despre comunitățile preistorice. În acest studiu propunem reconstituirea schemei de transformare a oaselor de ovicaprine în inele, pe baza analizei tehnologice, așa cum a fost identificată în așezarea de la Cheia (județul Constanța, România). De asemenea, abordarea noastră a fost facilitată de identificarea artefactelor în diferite etape de transformare, de la deșeuri de debitaj la piese finite cu urme de uzură. Ulterior, a fost dezvoltat un program experimental care să permită înregistrarea tuturor variabilelor: succesiunea etapelor de prelucrare pornind de la artefacte, tipurile de unelte utilizate, timpul înregistrat pentru fiecare operațiune etc. Scopul programului experimental a fost acela de validare a acestei scheme tehnice de transformare pentru obținerea inelelor de os.*

Abstract: *Studies on osseous objects specific to the Hamangia culture (5th millennium cal BC) have paid more attention to exotic raw materials, such as the Spondylus valve or the Antalis shell, to the detriment of local raw materials such as bone. However,*

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the latter can also provide us with important technological and cultural information about prehistoric communities. In this study we propose to reconstruct the ovicaprines bones scheme of transformation into rings, based on the technological analysis, as it was identified in the settlement of Cheia (Constanța County, Romania). Our approach was also facilitated by the identification of artifacts in various stages of transformation, from debitage waste to finished items with traces of use-wear. Next, an experimental program has been developed that allows for the recording of all variables: the sequence of procedures starting from the archaeological pieces, the types of tools used, time recorded for each operation, etc. The purpose of the experimental program was to validate the proposed technical transformation scheme for obtaining the bone rings.

INTRODUCTION

The sawing procedure for osseous materials segmentation aims to obtain blanks with predetermined dimensions, preserving their anatomical volume. It is made in a back-and-forth gesture with the help of an abrasive fiber or a flint tool with a long cutting edge (e.g. blade) and is applied transversely to the long axis of bone. The diagnostic element of this technological procedure is the appearance of a groove with a V-section (if a flint tool is used) or U-section (for abrasive fiber). On both walls of the groove, striations develop, the morphology of which also differs depending on the material used for segmentation (abrasive fiber *vs.* flint tool).

The appearance of the segmentation procedure of osseous materials by sawing, with abrasive fiber or with a flint tool is attested since the Mesolithic. Thus, in the Iron Gates settlements, from Ostrovul Banului[1] or Ostrovul Corbului[2], the procedure was applied for the segmentation of *Cervus elaphus* antlers, but its use was not identified in the case of bones. Bone segmentation by sawing appears in the Starčevo-Körös-Criș Culture[3], being attested at Starčevo-Grad site - Serbia[4], Kovačevo site - Bulgaria[5] or Măgura-Buduiasca site - Romania[6]. The procedure is well represented at the level of the Middle Neolithic (Măgura-Buduiasca site, Dudești levels[7]) and of some Eneolithic cultures (e.g. Măgura-Buduiasca site - Vădastra culture[8]; Issacea-Suhat site[9] - Boian culture or Cheia site - Hamangia culture[10]). During the evolution of the Gumelnița culture, the vegetal fiber is no longer used, sporadically appearing the sawing with a flint tool.

In this study, we will analyze the rings made of bone, as well as the debitage waste, blanks or preforms associated within the technological transformation scheme, discovered in the Hamangia settlement of Cheia (Constanța County). The assem-

[1] MĂRGĂRIT *et al*. 2017.
[2] MĂRGĂRIT *et al*. 2018a.
[3] SIDÉRA 2012.
[4] VITEZOVIĆ 2013.
[5] SIDÉRA 2012.
[6] BELDIMAN & SZTANCS 2009; 2013; MĂRGĂRIT *et al*. 2018b.
[7] MĂRGĂRIT *et al*. 2016; 2018b.
[8] MĂRGĂRIT *et al.* 2018c.
[9] MICU 2004.
[10] VOINEA *et al.* 2014.

blage does not impress by quantity (17 artifacts), but by the fact that products and by-products belonging to all technological stages have been identified.

Degree of processing	Species	Bone type	No. of pieces	Use-wear traces
Waste	*Ovis aries/ Capra hircus*	femur	1	-
Blank	*Ovis aries/ Capra hircus*	diaphysis	2	-
		femur	2	-
Preform	*Ovis aries/ Capra hircus*	diaphysis	1	-
Finished piece	*Ovis aries/ Capra hircus*	diaphysis	11	+

Table 1 - Products and by-products of the technological scheme for the bone transformation in rings at the settlement of Cheia

ARCHAEOLOGICAL CONTEXT

Archaeological research carried out in the Cheia village (Constanța county), which is located in the Casimcea Valley, in the centre of Karstic area of Dobrudja, has outlined a far better image than the one we used to have regarding Hamangia communities - new aspects of the economy, of domestic life, but especially of the spiritual complexity of the old communities. The systematic research carried out in the settlement started in 2001 and continues, with some interruptions (2013 and 2020), until today[11].

The settlement of Hamangia III from Cheia occupied the high plateau, in the area of the current village of Cheia, in the point called by the locals "*the Turkish Cemetery*"; the geo-physical surveys carried out in 2016 indicate a considerable inhabited area, about 7 ha (**Pl. 1**). Reaching a plateau near the Casimcea River, the new-comers have only built their dwellings after they have carried out founding rituals: large animal pieces (bovine, ovine and caprine, swine) have been laid in the layer of the dwelling's placement, beneath one of the walls[12]. The most consistent part comes from a calf, perhaps not accidentally, if we take into account the fact that the archaeo-zoological research has demonstrated the important role played by the cattle in this community's nourishment. Cheia is also the place where it was seen for the first time that the construction technique is much more evolved than it was believed to be for a long time.

The complex stratigraphy consisting of sedimentary deposits which exceed 3 m suggests a great dynamic of human settlement with consecutive returns, all dating to the Hamangia III phase. The four stratigraphic sequences have revealed a pattern of periodic occupation, with permanent habitat along the year, probably over years to decades, interrupted by abandonment phases long enough to lead to the destruction of deserted dwellings. Different dwellings have been documented during extensive excavation, revealing the scattered character of the settlement

[11] VOINEA *et al*. 2007; VOINEA & NEAGU 2008.

[12] VOINEA & NEAGU 2008; Fig. 8 / p. 25.

and a successive recurrence of habitat by communities. The settlement, which has been explored on a small scale, offered the most abundant faunal remains ever studied before. That is why it is not surprising the large number of pieces made of hard animal material (bone, antler, dentition, shells), especially pointed tools and ornaments, which are in different stages of processing[13]. Most items - in process and finished - come from the area of surface housing L.1 and L. 2 - interior and exterior occupational levels. The sieving of the sediment allowed the saving of small pieces, some of which were difficult to detect in the occupational level, mixed with ash.

ARCHAEOLOGICAL MATERIAL

Debitage waste (no=1)

This artifact (**Fig. 1/a**) is a femur epiphysis remaining from bone segmentation, to obtain the ring blanks. From a technological point of view, a wall with a slightly concave morphology and fine, long and parallel striations, located transversely on the long axis of the piece, is preserved at one end. These data show that the diaphysis was detached by a segmentation procedure with an abrasive fiber (**Fig. 1/b-c**). When the bone wall was thin enough, bending was applied from where its serrated morphology. The item is important because it contributes significantly to the reconstitution of the technical transformation scheme, especially since, usually, the debitage waste are not mentioned in the studies. Its length is 54 mm and its diameter is 16 mm.

Blanks (no=4)

First specimen (**Fig. 1/d**) analyzed is fractured longitudinally and transversely. It preserves two grooves resulting from a segmentation procedure that would have allowed, in the end, to obtain a ring. The segmentation procedure consists, in both cases, in a sawing applied with a flint tool (**Fig. 1/e-f**). The technological striations are arranged transversely to the long axis of the bone, but differ significantly from those made with abrasive fiber in the sense that they are deep and irregularly arranged. These striations are grouped in series that intersect with each other. At the periphery of the segmentation edge appear numerous cutting marks, resulting from tool sidesliping. Moreover, the groove is not continuous, like the one made with fiber, because the flint tool was progressively turned around the diameter of the bone (in the case of segmentation with fiber, the procedure starts in one direction, maintained until the final debitage). The segmentation procedure was finished only for the ring at the preserved end and it can be seen that bending was applied for detachment.

The second piece (**Fig. 1/g**) presents technological details identical to those of the piece described above, in the sense that two grooves were drawn, with the help of a flint tool (**Fig. 1/ h-i**), in order to obtain a ring. The current length of the piece is 62 mm and the diameter is 15.5 mm.

A caprine femur (**Fig. 2/a**), fractured at the level of the epiphyses preserves four segmentation grooves created by sawing with the help of a flint tool

[13] VOINEA *et al*. 2009; 2014.

(**Fig. 2/b-c**). It is a delineation procedure, which allowed the preview of the width of the future rings. Three rings would have resulted, following the finition of the segmentation procedure. The blank reflects the method of obtaining rings in series from a single bone. The actual length of the bone is 153 mm, the diameter 19 mm, while the average width of the rings was to be 8 mm.

The last blank (**Fig. 2/d**) is exceptional because it contributes significantly to the reconstruction of the technological scheme for obtaining the rings in series. And this time, a caprine femur was used. Nine grooves were drawn with a flint tool (**Fig. 2/e**), in a delineation procedure to determine the thickness of future rings. The detachment was performed by sawing with abrasive fiber (**Fig. 2/f**), as demonstrated by the first groove - where the procedure was completed and the second groove - where the segmentation procedure was initiated. The current length of the bone is 95 mm, the diameter is 14.4 mm, and the average width of the rings was to be 5.5 mm.

Preform (no=1)

One piece (**Fig. 2/g**) was included in the preform category. The blank was obtained by sawing with abrasive fiber (**Fig. 2/h**), with specific striation visible on the blank wall. The segmentation plan was not shaped. On the medullary canal, a transverse scraping was applied to the longitudinal axis (**Fig. 2/i**), meant to clean the wall and widen the hole. The outer diameter of the preform is 23.4 mm, the inner diameter is 15 mm, and the width is 7 mm.

Finished pieces (no=11)

The first ring (**Fig. 3/a**) was obtained by an abrasive fiber sawing procedure (**Fig. 3/b**). The technological marks described above are difficult to identify, because the segmentation plane was shaped by abrasion (**Fig. 3/c**). In addition, the medullary canal was cleaned and widened by scraping arranged transversely to the bone axis (**Fig. 3/d**). The item was used, under the microscope being visible two areas of use-wear. The first develops at the periphery of the segmentation plane, towards the inner channel and consists in eliminating the abrasion striation, the surface flattening and acquiring a macroscopic polish (**Fig. 3/e**). The second use-wear area is on the external side (**Fig. 3/f**), at the median level and appeared as a result of prolonged handling. It is characterized by the same phenomenon of flattening of the bone convexity and the appearance of irregularly arranged striations. The outer diameter of the ring is 17 mm, the inner diameter is 13 mm and the width is 6.5 mm.

The second unfractured specimen (**Fig. 3/g**) was obtained by the same segmentation method. Unlike the previous piece, some debitage marks are visible (**Fig. 3/h**) at the periphery of the segmentation plane, which could come from the initial delineation procedure. The segmentation plane was abraded (**Fig. 3/i**), and the canal was widened by scraping (**Fig. 3/j**). In this area, the use-wear is evident especially at the level of the segmentation plane (**Fig. 3/ k-l**), with the disappearance of technological marks, flattening and macroscopic polish. The morphometric data are as follows: outer diameter - 13 mm, inner diameter - 13 mm, and width of 5.4 mm.

The next ring (**Fig. 4/a**) was not intensely used, keeping most of the traces of the technological procedures. The segmentation was made with abrasive fiber (**Fig. 4/b**), but the direction of the segmentation groove could not be kept and there were slips, those maintaining under the form of grooves with a section shaped in U and fine striations (**Fig. 4/c**). The segmentation plan was regularized through abrasion (**Fig. 4/d**). Also, the internal scraping is visible (**Fig. 4/e**), being unaffected by the use-wear. The external diameter of the ring has 18 mm, the internal diameter has 12.8 mm and the width has 5.6 mm.

The fourth item (**Fig. 4/f**) has a green colour witch, according to the previous studies[14], it seems to have been intentional. The segmentation was made through sawing with abrasive fibre (**Fig. 4/g**), after that the extremities were regularized through abrasion (**Fig. 4/h**). Scraping (**Fig. 4/i**) was applied to the medullary canal (**Fig. 4/i**) but this time it is parallel to the longitudinal axis of the bone. The piece was used, the abrasion marks have been eliminated towards the periphery of the segmentation plane where a macroscopic polish has been developed (**Fig. 4/j**). This also appears on the external side, at the median level, most likely from prolonged contact with the user's hand. The outer diameter of the ring is 16 mm, the inner diameter is 13.6 mm and the width is 6 mm.

The black coloring of the next ring (**Fig. 5/a**), which is fractured, also seems intentional. The color accentuated the technological marks, especially those of segmentation by sawing (**Fig. 5/b**) and widening of the medullary canal by scraping (**Fig. 5/b**). The abrasion marks of the segmentation plane are blurred, being superimposed by use-wear. The ring has an outer diameter of 22.3 mm, an inner diameter of 16.5 mm and a width of 4.8 mm.

Another ring (**Fig. 5/d**), also fractured, is the widest specimen (12 mm) from the Cheia assemblage. The marks of the segmentation procedure are quite difficult to identify (**Fig. 5/e**), due to the abrasion shaping of the segmentation plane (**Fig. 5/f**). For this specimen, both the external (**Fig. 5/g**) and the internal side were cleaned by a scraping arranged transversely. At the periphery of the segmentation plane, towards medullary canal, an area characterized by macroscopic polish develops (Fig. 5/h), with the disappearance of technological marks, proving that the piece was used.

Although quite fragmented, three other rings (**Fig. 5/i**) preserve technological marks that demonstrate the use of the same technological scheme: segmentation by sawing (**Fig. 5/j**), medullary canal scraping (**Fig. 5/l**), abrasion of segmentation plane and external side (**Fig. 5/k**). A macroscopic polish develops on the entire surface of the fragments, while on the external side, at the median level, a flattened area was formed (**Fig. 5/m**), with irregularly arranged striations. All this shows us that these are fragments from items that have been used for a long time. The width of the fragments is 7 mm, 4.8 mm and 3 mm, respectively.

Finally, for the last two ring fragments, use-wear is not as advanced as in the previously described items. As a result, the technological marks of the debitage (segmentation by sawing) and shaping (abrasion - segmentation plane and

[14] VOINEA *et al*. 2014.

external side, scraping - medullary canal) operations are visible. The width of the items is 9.8 mm and 4 mm, respectively.

EXPERIMENTAL REPLICA

Starting from the data identified at the level of the archaeological pieces, we made replicas, which to allow us a vision over all the variables involved in these techniques of processing osseous materials. As a first stage, we developed a descriptive chart which to include all the stages of the operational scheme, with the registration of the used raw materials, of the necessary time for each type of operation, of the tools we have worked with, and of the results obtained for each operation (macro-marks).

Two 12-month-old *Capra hircus* femurs were used (**Fig. 6/a**). The first operation was to clean the periosteum (**Fig. 6/b**) of all meat and fat residues with the help of flint splinters. Epiphyseal cleaning is a very careful operation, so the process took 20 minutes. In order to visualize the width of the intended blanks, a delineation procedure was applied by sawing with a lithic tool (**Fig. 6/c**), operation lasting 10 minutes. This way, a groove was drawn around the entire circumference. Further on, the process continued with segmentation by sawing with a fiber, the groove was also used to stop the thread from sliding until the groove was sufficiently deep to hold it in place (**Fig. 6/d; 7/a**). At this stage, abrasive fiber and sand were used. Periodically, water was added to facilitate the fixation of the sand on the fiber and the intensification of the friction process. The procedure goes quite quickly with each segmentation taking approximately 7 minutes. Initially, the string slides and the trajectory has to be straightened, situation also identified in the archaeological pieces. From the moment the groove is sufficiently deep the procedure becomes very efficient.

The segmentation cannot be finalized by this procedure, in the end the bone must detached by bending (**Fig. 6/e; 7/b**). The result appears as a snap flake that was also observed on the archaeological pieces. But the bending cannot be applied prematurely, otherwise there is a possibility of an accidental crack appearing, creating an irregular fracture. The string broke many times, needing replacement. In the end, this work resulted in a few blanks with volume and two pieces of debitage waste (**Fig. 7/d**). Under a microscope one can see development of certain technological marks that are similar to those found on archaeological pieces: a polished wall with a slightly concave morphology and fine striations sitting transversally to the long axis of the piece (**Fig. 8/a-b**).

As we identified at the finished items, the medullary canal was cleaned with a flint tool, in a scraping motion transverse to the axis of the blank (**Fig. 8/d**). The procedure is fast, taking about 2 minutes. Finally, the segmentation edges were regularized by abrasion on a stone (**Fig. 7/c; 8/c**), to which sand and water were constantly added for 4 minutes. Thus, the extremities acquired a rounded and regular morphology. Among the stages of the technological scheme, the segmentation procedure was the longest, the other stages of regularization and finishing being very fast, precisely because this method allows obtaining regular shaped blanks.

DISCUSSION

Raw material. For all specimens, ovicaprines bones were used, which involved only one method of acquisition: recovery of the raw materials from the household waste. Moreover, starting from the pieces that could be determined, it was established that the femur was the only type of bone used. In this case, it was an opportunistic selection with minimal effort, studies showing the predominance of animal husbandry in the economy of the settlement of Cheia, with the exploitation of cattle and goats and, much less often, domestic pigs[15].

We can conclude that the exploitation of raw materials is centered, at least in this case, around the activities of animal husbandry. These were obtained from the available culinary remains, the production taking place *in situ*, resulting in artifacts also used in domestic activities (see *Functional hypotheses*).

Technical transformation scheme. Starting from the composition of the studied archaeological assemblage, we identified four types of products and by-products resulting from the technological transformation scheme, meant to obtain the rings:

- debitage waste - epiphyses that could not be used as blanks;
- blanks - unshaped products, derived from debitage operation, which are suitable for later processing into finished objects:
- preforms - items in different stages of processing, important because they retain many marks of the technological scheme, especially of the shaping operation;
- finished objects that have been used.

Study of the above listed categories highlighted an extremely unitary raw material transformation scheme, with few variables. As a detachment procedure, it was used exclusively a transversal debitage to which is subordinated a transformation scheme by segmentation. Blanks that preserve the anatomical volume were obtained. The transversal segmentation was made by sawing, applied with the help of a flint tool or an abrasive fiber.

For the surface modification procedures, abrasion was the most commonly used technique to regularize the segmentation plane and, in some cases, the external face, followed by scraping, meant to regularize and widen the medullary canal. These processes can be supplemented by the sawing with flint tools, when it is intended to delimit the width of future rings.

The synthetic picture of the technological scheme for obtaining the rings consists in a first stage of delineation, by sawing with a flint tool, of the future rings, in order to pre-visualize their dimensions. Thus, a groove was drawn around the entire circumference, also using it to block the tool that tends to slip (the cutting marks present at the periphery of the segmentation plane are evidence of tool slipping during the technological procedures), until the groove gets deep enough. The debitage procedures, could be continued either by the same type of sawing or by means of an abrasive fiber. The final detachment was made by bending. However, the bending should not be applied prematurely, otherwise an irregular fracturing plan in the saw teeth may occur. The epiphyses

[15] BĂLĂȘESCU & RADU 2004; BALASSE *et al.* 2014.

were removed, they became debris and only the diaphyseal wall was used. From this, several blanks could be obtained (on one of the specimens, no less than 8 rings are drawn). After obtaining the blanks, the segmentation plan was regularized by abrasion, in some specimens the abrasion was applied on the external side. The medullary canal was processed at all specimens by scraping.

The sawing segmentation procedure involves a major investment of time, but has the advantage of previewing the shape and size of the future blank, and the risk of accidental fractures is lower. In later cultural stages (e.g. Gumelnița culture) even if the procedure of segmentation by sawing with a flint tool still appears, the segmentation by direct percussion seems to predominate, completed in a few seconds. We are talking about superior technological skills, because, according to the experiments we performed, a fairly regular transversal segmentation, without longitudinal cracks that compromise the diaphysis (the one that will be processed), is obtained only in direct percussion[16]. It requires a massive flint tool, with a sharp edge and the application of a short and strong blow. With just a few hits, the crack can be initiated, which will allow detachment. It can be continued with hits, around the entire circumference or with detachment by bending, in this case, however, there is a risk of developing an irregular crack, which would compromise the blank. We have emphasized these characteristics of the hammer because from our own experiments, if a round hammer is used, in a diffuse percussion, the result is the development of multiple cracks in the longitudinal direction, as a result of which flat blanks are obtained.

In the case of rings, the reason for using the vegetable fiber segmentation procedure, to the detriment of percussion segmentation, is obvious. It is desired to obtain regular blanks, a necessary condition for an expected aesthetic impact, in which to invest a minimum effort in the shaping stage.

Functional hypotheses. Some of the finished pieces preserve traces which can give us clues as to how to use them. On the surface of the used items, two areas of wear could be identified. The first develops at the median level, on the external side, and consists in flattening the surface, in association with a macroscopic polish and sporadic striations, irregularly arranged. This type of wear occurs as a result of prolonged contact with the hand. The second area of wear was identified at the periphery of the segmentation plane, on the inner surface, consisting in the disappearance of abrasion marks, flattening of the surface and macroscopic polish. We assume that this area was in long contact with a material passing through the bone canal.

The morphology of the pieces analyzed in this study seems compatible with the rings, however, the small diameter of the caprine bones shows that the pieces could not be used as rings, worn by adults on the fingers. If they were, however, ornaments could be used to hold the hair.

Another functional hypothesis associates these rings with the processing baskets from vegetable fibers[17]. The rings caught and held the wicker bundles that were woven into baskets. For the settlement from Cheia, the hypothesis is supported by the presence of a significant number of pointed tools, which by

[16] MĂRGĂRIT *et al.* 2018b

[17] SIDÉRA 2000, Fig. 25.

morphology and development of wear, do not seem associated with hunting activities but rather the same activity of weaving vegetable fibers.

CONCLUSION

We can conclude that the use of these technological procedures was, ultimately, a cultural option and not a technological one, certain processes being interconnected to certain typological categories (rings on volume blank - segmentation with vegetable fiber). When the type of piece is abandoned in the Gumelnița culture, the procedures that accompanied it disappears. Once again, the importance of the cultural determinant in the technology of prehistoric communities is highlighted, already emphasized by many specialists[18]. In terms of the animal hard materials industry, we can say that, at least in the case of the analyzed process, it can become a cultural landmark, as long as we can draw, quite clearly, the moment of its abandonment, probably under the impulse of new economic imperatives and a cultural breakdown. Indeed, a mutation in the symbolic relations with the animal environment seems to be seen during the evolution of the Gumelnița culture, in the Northern Danube area, the place of the bone being taken by the *Cervus elaphus* antler and the place of the elaborated technological procedures seems to be taken by those involving simpler transformation schemes.

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Pl. 1 – Map of Settlement Hamangia III from Cheia – Casimcea Valley.

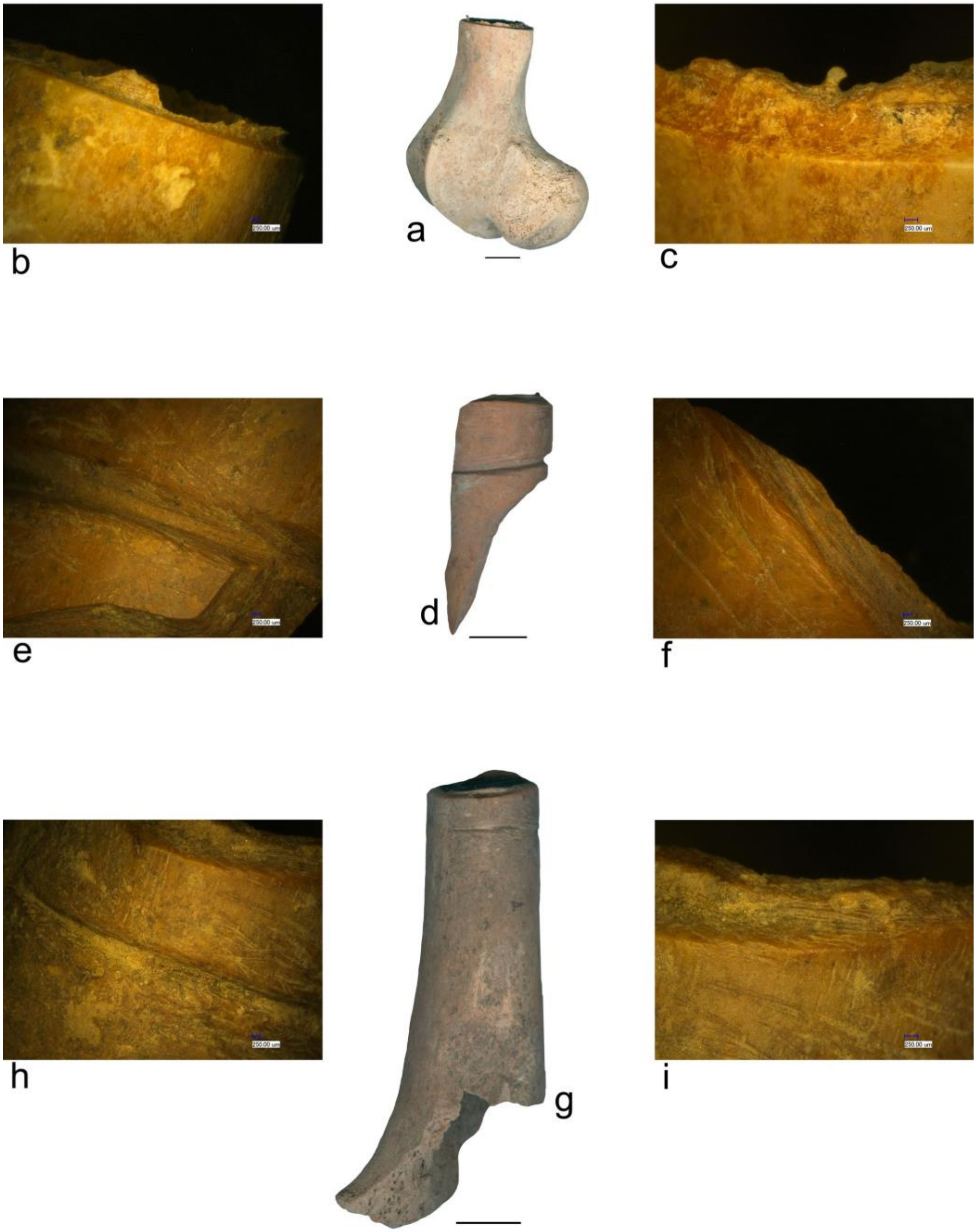

Fig. 1 – Debitage waste and blanks: a - debitage waste; d, g - blanks; b-c, e-f, h-i - details of the segmentation procedure by sawing.

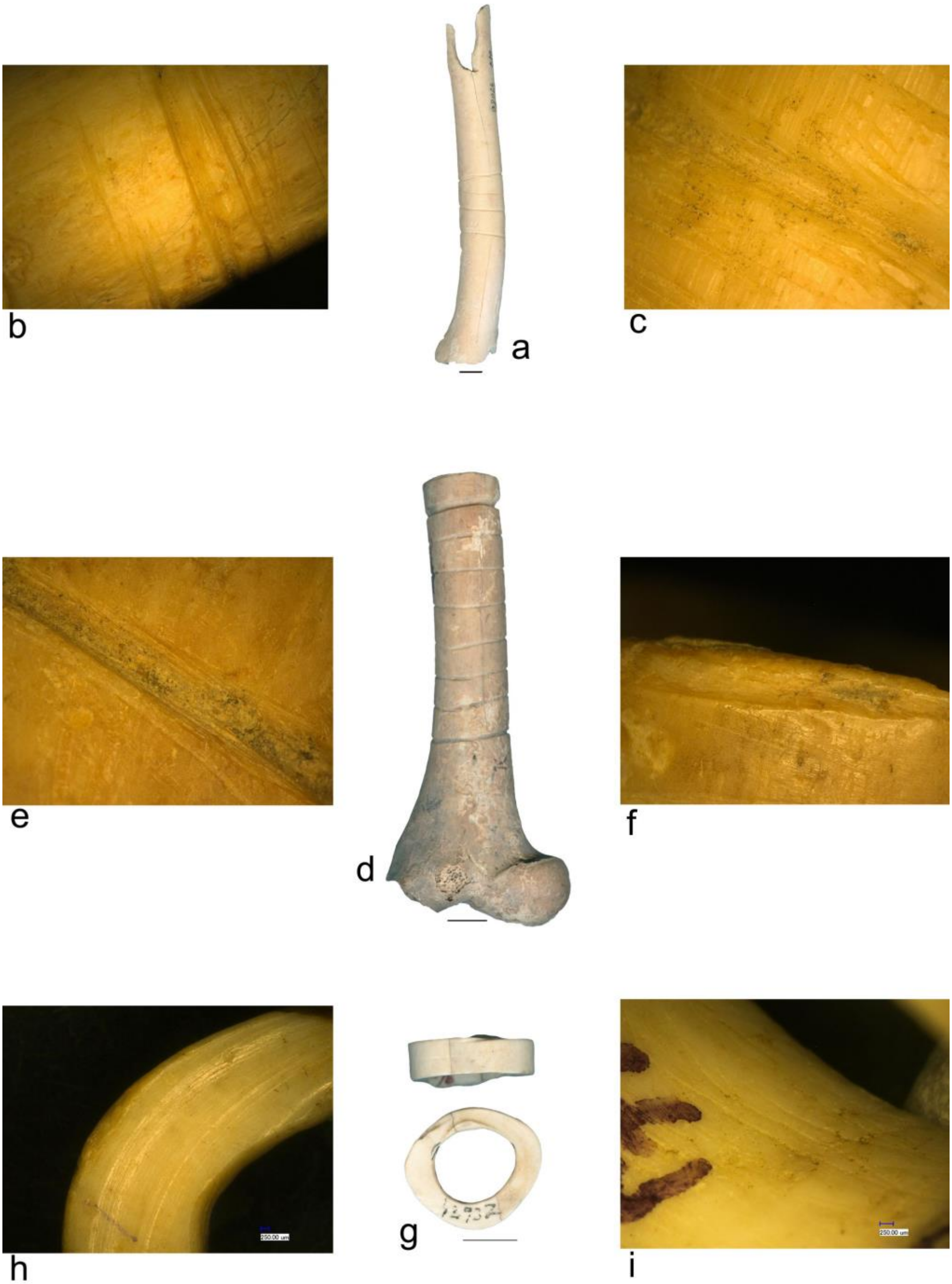

Fig. 2 - Blanks and preform: a, d - blanks; g - preform; b-c, e-f - details of the segmentation procedure by sawing; h - segmentation groove morphology detail; i - traces of scraping on the inner wall of the bone.

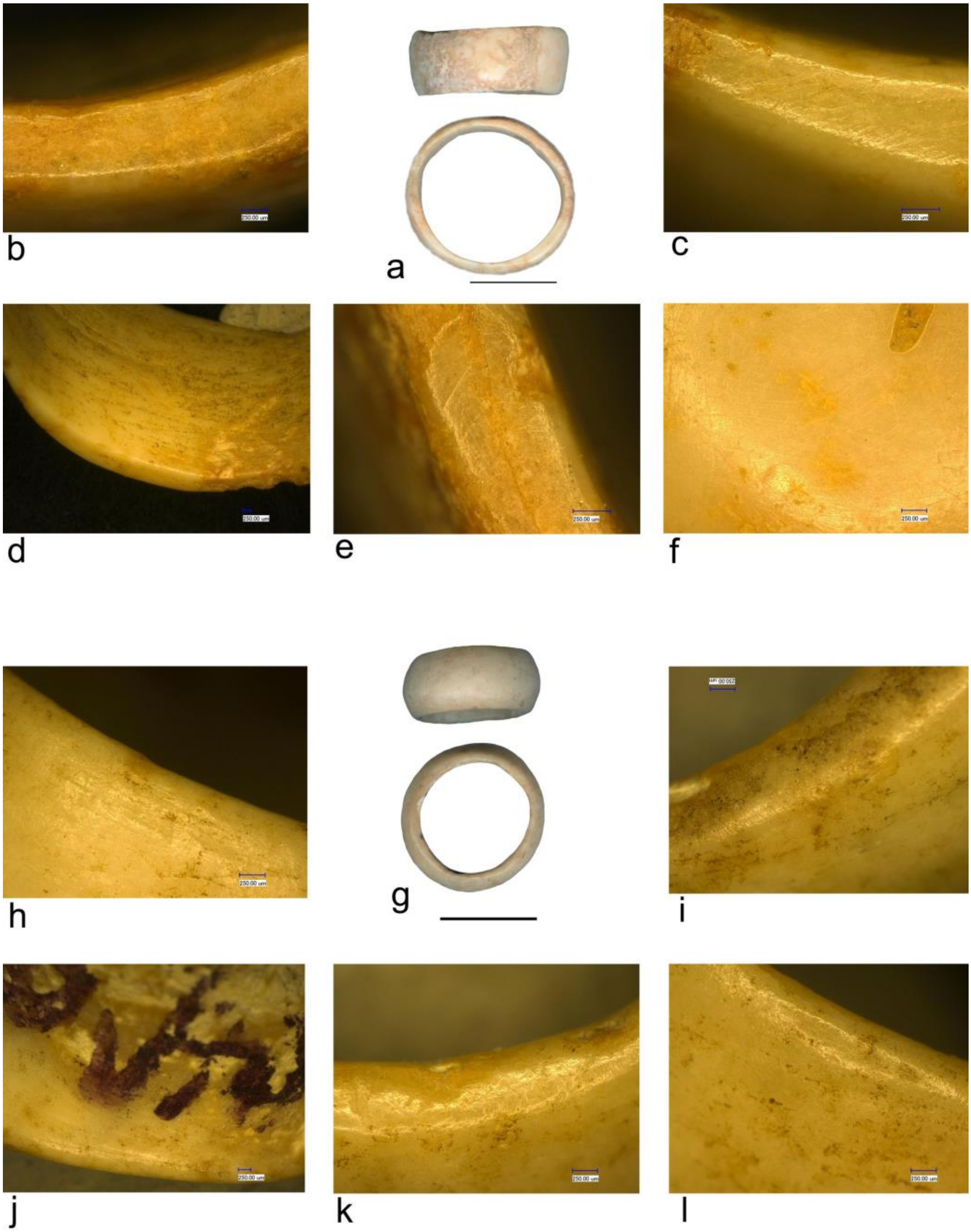

Fig. 3 - Finished pieces: a, g - rings; b, h - segmentation plan detail; c, i - abrasion marks; d, j- scraping marks; e-f, k-l - traces of the use-wear.

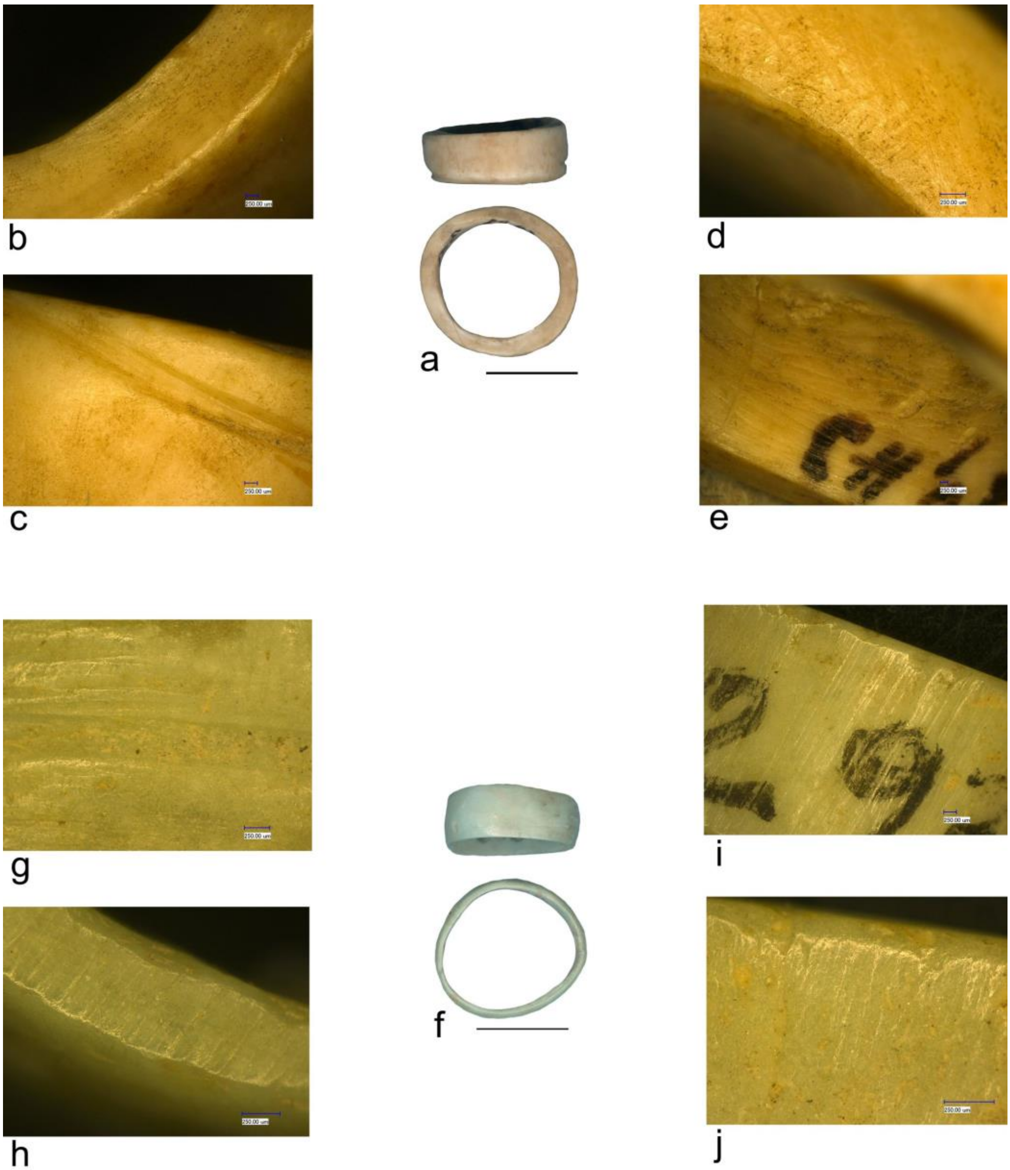

Fig. 4 - Finished pieces: a, f - rings; b-c, g - segmentation plan detail; d, h - abrasion marks; e, i - scraping marks; j - traces of use-wear.

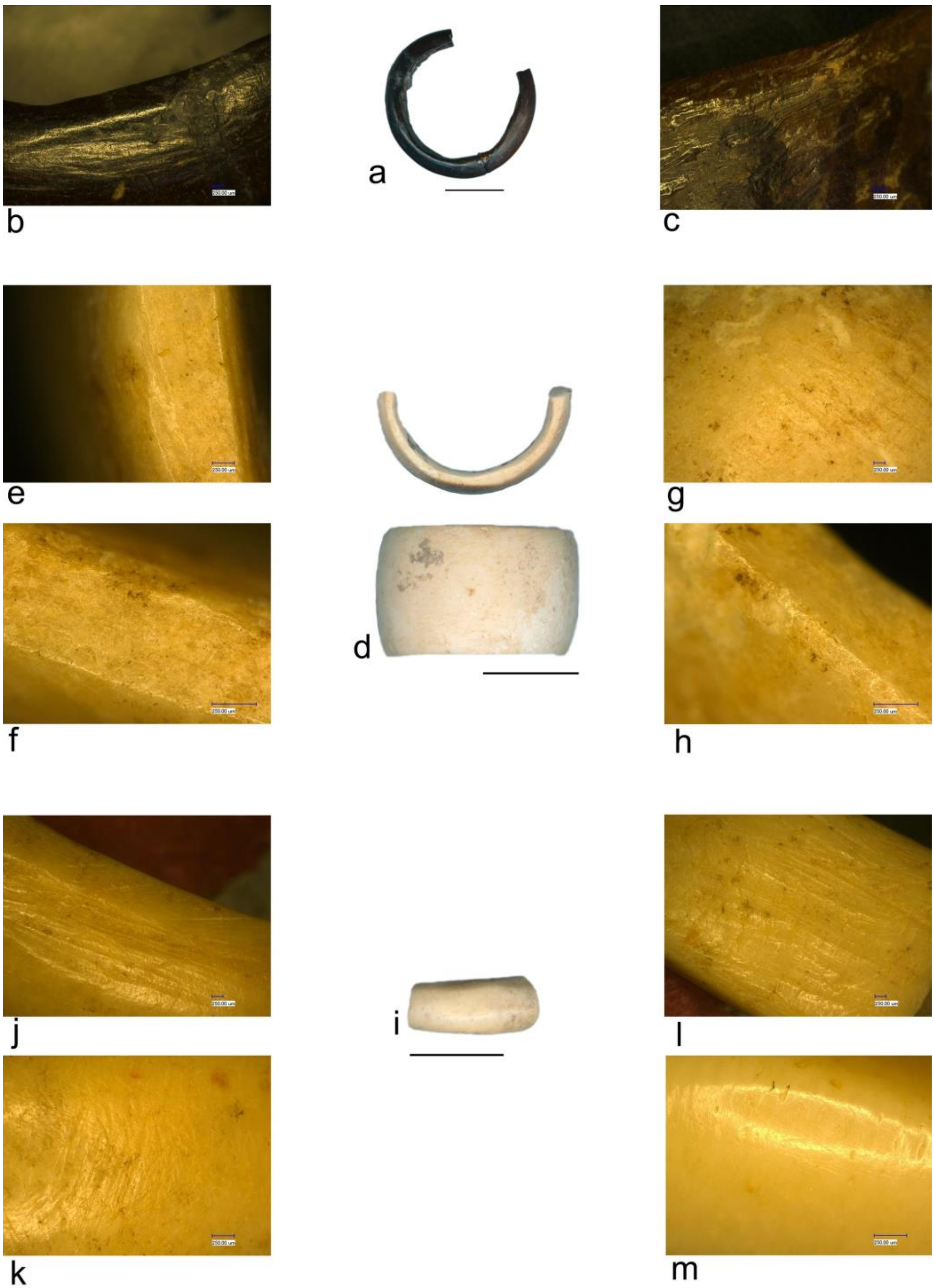

Fig. 5 - Finished pieces: a, d, i - rings; b, e, j - segmentation plan detail; f, k - abrasion marks; c, g, l - scraping marks; h, m - traces of use-wear.

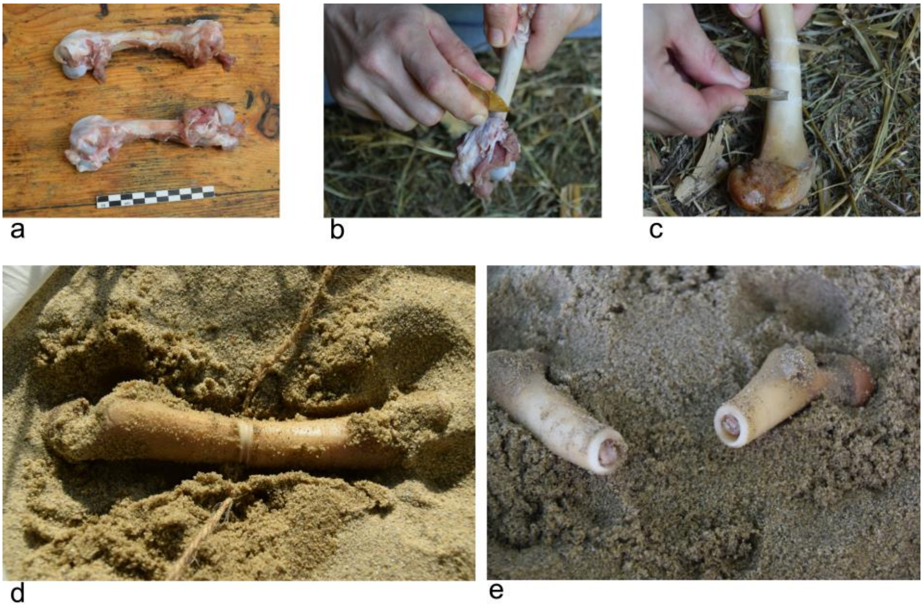

Fig. 6 - Experimental program: a. Caprine bones used in the experimental workshop; b. cleaning the periosteum; c. the procedure of delineation; d-e. segmentation with abrasive fiber.

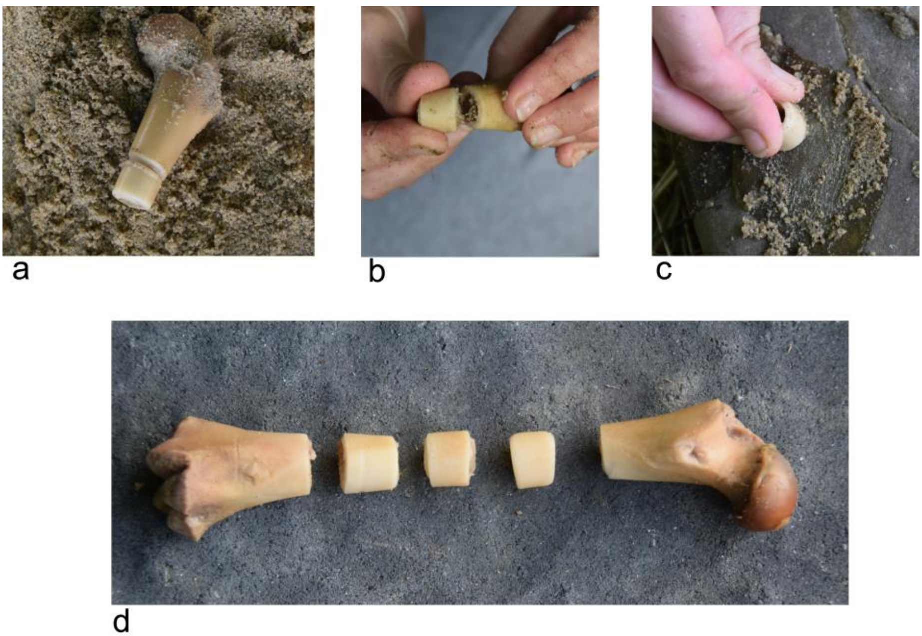

Fig. 7 - Experimental program: a-b. ring detachment; c. abrasion of the segmentation plan; c. products and by-products resulting from this technological scheme of bone transformation.

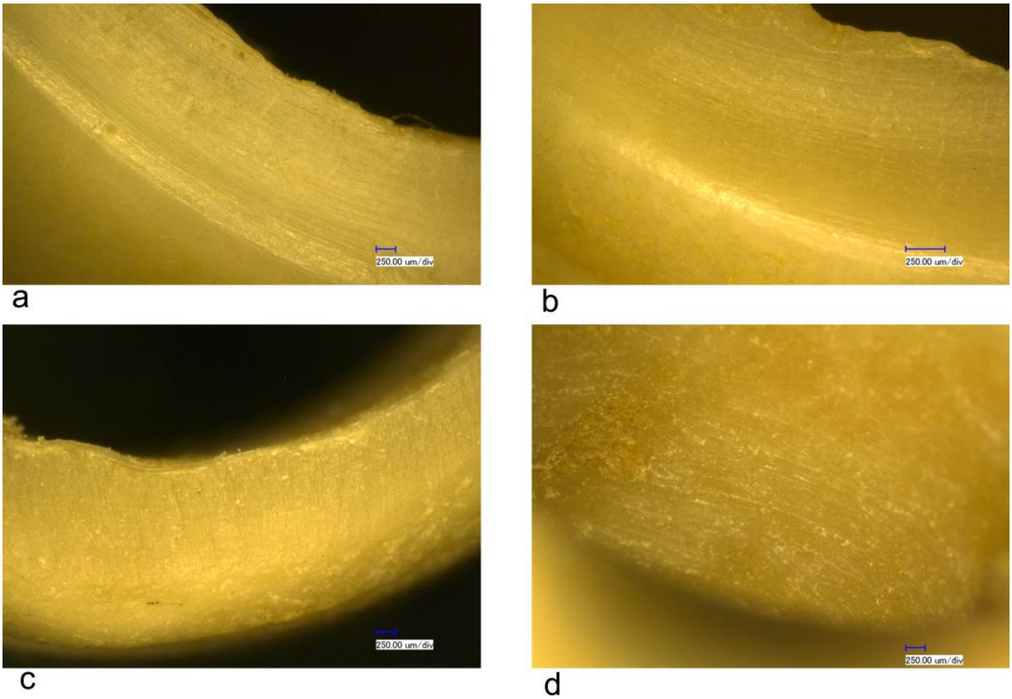

Fig. 8 - Technological marks of experimental pieces: a-b. segmentation with abrasive fiber; c. abrasion marks; d. scraping marks.