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Textile research in the Croatian Science Foundation's project *Creating European Identities*

Introduction

As part of the project “Creating European Identities – Food, Textiles, and Metals in the Iron Age between the Alps, Pannonia, and the Balkans” (2020–2024) the topic of textiles was addressed through investigation

of textile remains and tools from sites in the territories of Slovenia, Croatia, Bosnia and Herzegovina, and Serbia (fig. 1). The project (CSF IP-2020-02-2371, IronFoodTexMet) was led by Hrvoje Potrebica from the University of Zagreb, Faculty of Humanities and

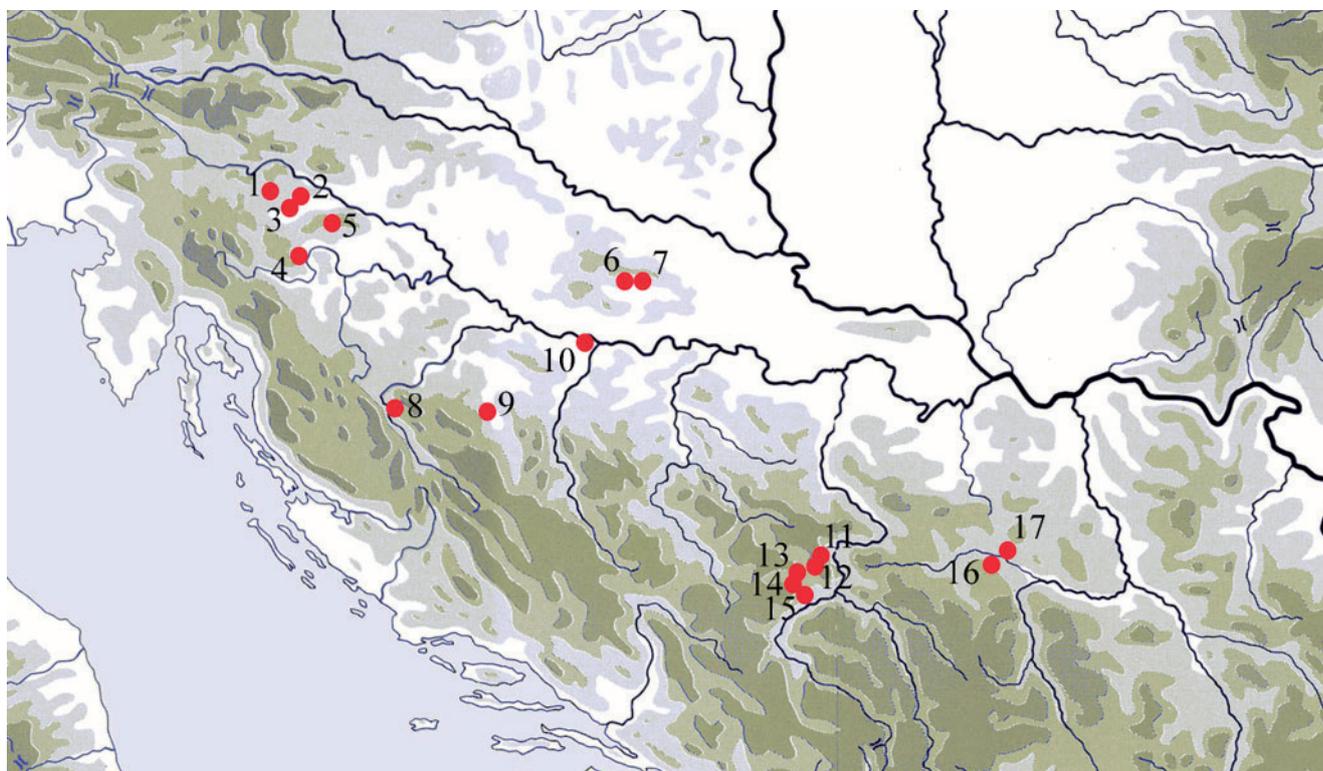


Fig. 1: Map showing the sites from which textile production tools and samples of mineralised textiles analysed in the IronFoodTexMet project originate: 1) Medvedjek, SLO; 2) Ivanec, SLO; 3) Novo Mesto, SLO; 4) Podzemelj, SLO; 5) Budinjak, CRO; 6) Kaptol, CRO; 7) Vetovo, CRO; 8) Ripač, BiH; 9) Sanski Most, BiH; 10) Donja Dolina, BiH; 11) Sjevsko, BiH; 12) Osovo, BiH; 13) Rusanovići, BiH; 14) Kovačev Do, BiH; 15) Ilijak, BiH; 16) Atenica, SRB; 17) Mojsinje, SRB (Image: Julia Fileš Kramberger)

Social Sciences, and was funded by the Croatian Science Foundation. The aims of the research were to identify the impact of textiles and textile production on societies and their cultural networks in the first millennium BCE through studies focused on techniques of yarn and fabric production.

Material

Textile production tools

The *chaîne opératoire* of textile production involves a series of steps from the procurement of raw materials to the creation of finished textile products (Andersson Strand 2012; Grömer 2016). Textiles are the result

A

Site	Spindle Whorls	Loom Weights	Spools	Smootherers
Sanski Most	26	35	30	0
Donja Dolina	1,995	569	290	33
Ripač	13	81	22	0
Kaptol	79	121	1	0
Kagovac	4	0	0	0
Novo Mesto	25	3	0	0
Total	2,142	809	343	33

B

Site	Location	Grave	Find no.	Object	SEM analysis
Brezje/Glasinac	Tumulus III	Grave 5	13512	iron ring	yes
Gosinja Planina	Tumulus XXXVII	Grave 2	11284	fibula	no
Ilijak	Tumulus TXIII	Grave 2	5676	fibula	yes
Ilijak	Tumulus TXIII	Grave 2	5683	spearhead	yes
Ilijak	Tumulus TXIII	Grave 2	5684	spearhead	yes
Kovačev Do	Tumulus I		3012	fibula	yes
Kovačev Do	Tumulus III	Grave 1	3010	fibula	yes
Kovačev Do	Tumulus III	Grave 1	3010	fibula	yes
Osovo II			11514	fibula	yes
Podilijak	Tumulus B	Grave 1	41667	knife	yes
Podilijak	Tumulus B	Grave 11	41723	knife	yes
Podilijak	Tumulus B	Grave 7	41707	iron fragments	yes
Rusanovići	Tumulus X	Grave 1	11900-11904	whetstone with bronze handle	yes
Rusanovići	Tumulus X	Grave 1	21742	fibula	yes
Rusanovići	Tumulus XXXIX		7240	fibula	yes
Sanski Most		111/69	12525?	bronze belt	yes
Sanski Most		122	12595	fibula	yes

Table 1: Number of analysed finds related to textile production through the IronFoodTexMet project: A) textile tools; B) mineralised textile remains from sites in Bosnia and Herzegovina

not only of the technical procedures of spinning and weaving but also of social needs that shape the use of resources and the development of technology (Andersson Strand et al. 2010). Production requires specific knowledge, skills, tools, and appropriate spaces to effectively carry out the individual steps. In total, over 3,300 textile-related implements were analysed. Table 1 summarises the number of recorded items from each site.

From Tumulus X at the Kapiteljska njiva site in Novo Mesto, Slovenia, 28 items were examined. From the settlement and necropolis of Kaptol-Gradci, as well as from Tumulus 1 at Vetovo-Kagovac, Croatia, 205 finds were analysed. Most of the corpus comes from Bosnia and Herzegovina, including 2,887 items from Donja Dolina, 91 items from Sanski Most, and 116 items from Ripač.

The most numerous category of finds consists of spindle whorls, followed by loom weights, spools, and smoothers. In Donja Dolina, most of the finds originate from the settlement areas of Gradina and the pile dwellings, with only 5% of the analysed material found in burial contexts at the Greda site. The finds from Ripač come from the settlement area, while those from Sanski Most originate from unknown locations along the Sana River and outside of grave structures.

Textiles

Most textiles analysed during the project have been preserved in a mineralised state, primarily in contact with iron, and in some cases with bronze, while only three examples of organic textile remains survived.

A total of 81 finds of mineralised textile fragments were analysed, all originating from burial contexts. In Slovenia, 30 textile finds were analysed from the sites of Novo Mesto, Medvedjek, Ivanec, and Podzemelj. In Croatia, 28 finds of mineralised fabric were analysed from Budinjak, Kaptol, and Vetovo-Kagovac. In Bosnia and Herzegovina, 18 finds were analysed, specifically from the sites of Brezje, Gosinja Planina, Kovačev Do, Osovo, Ilijak, Podilijak, Sjeversko, Rusanovići, and Sanski Most. In Serbia, 5 finds were analysed, from the sites of Atenica and Mojsinje. From these finds, a total of 68 samples were taken for fibre analysis using Scanning Electron Microscopy (SEM).

Methodology

The morphological analysis of textile production tools aids in understanding archaeological contexts, as their dimensions, mass, and ratios are key factors in yarn and fabric creation. Finds were catalogued in an Excel table, adapted from the Centre for Textile Research Textile Tools Database (Andersson Strand and Nosch 2015; University of Copenhagen; <http://ctr.hum>).



Fig. 2: Textile tool finds from the settlement of Donja Dolina (BiH). A and D) textile tools (spindle whorls and spools) from several unknown locations of the pile-dwelling settlement; B and C) textile tool assemblages found in Houses 4 and 1, respectively, at the pile-dwelling settlement (Image: Julia Fileš Kramberger)

ku.dk/). Measurements of relevant morphological parameters were taken with digital calipers or rulers. Additionally, weight, surface treatments, use-wear, and damage were documented.

Textiles underwent technological and fibre characterisation analysis to determine culturally and chronologically relevant fabric characteristics. Technological analysis involved examining weave type, thread count, twist, diameter, angle, and features like edges and patterns, using visual observation and digital microscopy at various magnifications. Fibre analysis aimed to identify the raw material, aiding in understanding processing and thread structure (spinning or splicing). Microscopic (1–10 mm) samples were taken for fibre characterisation, which was carried out using SEM at the McDonald Institute for Archaeological Research at the University of Cambridge and the University of Padua.

Preliminary results and outlook

Over 2900 textile tools From Donja Dolina (BiH) (fig. 2), were analysed as part of a PhD research and included spindle whorls, loom weights, spools, and smoothers—revealing significant variation in form, function, and manufacture (Fileš Kramberger 2024). Clay spindle whorls (2.9–4.9 cm diameter; 1.4–2.8 cm height) are mostly biconical or lenticular, often decorated, and grouped by weight—lighter ones for fine yarn, heavier possibly for thick yarn or as loom weights. Loom weights (3.5–20+ cm; 24–2200+ g) are usually pyramidal or trapezoidal. Clay spools (avg. 6.1 × 4.6 cm, 157 g) may have served as bobbins, yarn holders, or weights (depending on weight). Smoothers (averaging 7 cm, 122 g) with flat bases and handles were likely used for pleating, pressing, or pigment application, although their function remains hypothetical, pending experimental confirmation.

The precise dating of the tools from Donja Dolina is quite challenging due to limited contextual data, though most likely they originate from the period between the seventh and early third century BCE, when Donja Dolina's Gradina hillfort was occupied. The tools from other analysed sites researched within the project show similar characteristics with certain variations, depending on context (settlement or funeral). Further research into these assemblages as well as their inter-site comparison might show certain local stylistic preferences in tool shaping, as well as possible nuances in textile production techniques.

The diversity in the shaping of spindle whorls and loom weights in Croatia and BiH indicates a variety in yarn and fabric production – from very fine wool yarns and dense fabrics to thicker flax threads, plied yarns,

and coarser weaves. Spindle whorls in Slovenia are generally conical, while biconical and lenticular shapes prevail in eastern Croatia and Bosnia. Perforations of the spindle whorls are significantly larger in Donja Dolina than at other nearby sites indicating the use of thicker spindles at this site. The use of very large loom weights weighing over 5 kg in Donja Dolina suggests a possible special weaving technique that may have preceded the introduction of a two-beam loom. It is furthermore worth emphasising that, judging by the high density of textile tools across settlements, textile production in the Early Iron Age was not the prerogative of specialised workshops, but rather was carried out in almost every household.

The presence of varied and, in several cases, numerous spindle whorls within graves in Slovenia, Croatia, and Bosnia and Herzegovina (Fiala 1896; Truhelka 1901; Teržan 1990; Dular 2003; Križ 2019; Potrebica

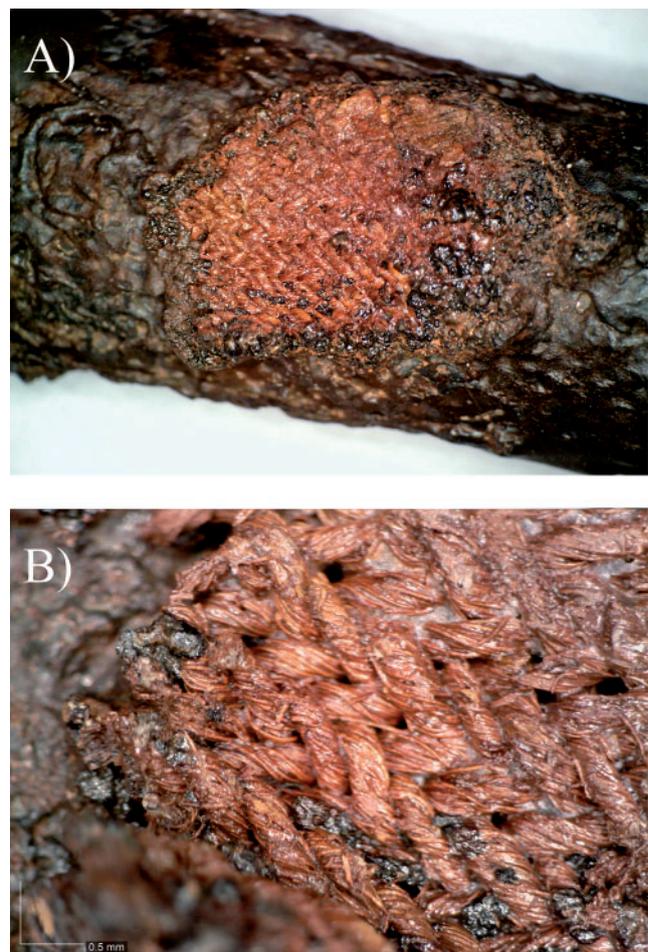


Fig. 3: Mineralised textile remains found on an iron piece of horse-gear from the princely Tumulus 6 at Kaptol, Croatia: A) preserved twill fragment; B) Dino-Lite image at x20 magnification (Images: Julia Fileš Kramberger)



and Fileš Kramberger 2020; Fileš Kramberger 2024) points to a symbolic connection of textile production tools with women in whose graves they are most often found. Possibly, spindle whorls symbolise the deceased woman's gender, but also potentially her occupation, and even her role and status in society (Gleba 2008; Potrebica and Fileš Kramberger 2020; Fileš Kramberger 2024). At Bosnian sites, the quantity of spindle whorls in graves appears to be somewhat

more limited, although, in the somewhat later Early Iron Age cemetery in Sanski Most, spools are also found in graves, while they are rare in Donja Dolina. When it comes to textiles, twill weaves are typical for the Italic and central European textile culture during the Iron Age (Lau 2021; Gleba 2017; Grömer 2016; Grömer et al. 2013). The results of textile analysis carried out through the IronFoodTexMet project confirm this trend for Slovenia and Croatia (fig. 3)



Fig. 4: Hallstatt days festival: A) speakers of the *Iron age textiles: stories from European Crossroads* scientific conference (back left to right: Peter Grömer-Mrazek, Hrvoje Potrebica, Matija Črešnar, Borut Križ; front left to right: K. Rupert, Julia Fileš Kramberger, Karina Grömer, Kayleigh Saunderson, Ronja Lau, Bela Dimova, Margarita Gleba); B) Roman togatus at the *Catwalk to the past* fashion show at Kaptol main square; C) detail from the handweaving workshop (Images: A: Kristina Rupert, B and C: TZ Zlatni Papuk/StiglicPhoto)

(Fileš Kramberger 2022a; Gleba et al. 2024; Gleba in press). Weft-faced tabbies, on the other hand, are typical for the Aegean region and western Asia in the first half of the first millennium BCE, where twills or tablet-woven textiles have not been identified so far (Gleba 2017). The weft-faced tabbies from Atenica and Mojsinje point to connections between the area of present-day Serbia and the south, specifically Greece. The Bosnian region seems to be at the crossroads of these two textile cultures, with the presence of both twills and weft-faced tabbies, although the latter are on average of coarser quality than the fabrics from Italy/central Europe and Greece.

A peculiarity of all recorded wool textiles in Bosnia is the use of plied spun yarn in both systems. So far, the use of plied yarn in both systems, especially in twill, has only been documented in western Europe, and is specifically associated with the western Hallstatt area (southwestern Germany, France, and even further, Spain). In wool weft-faced tabbies, the use of plied yarn is known only in the Aegean region and western Asia. In Bosnia, however, the use of plied yarn appears to be a local tradition not recorded so far in other parts of the region and connected to the quality of raw material. The uniformity of wool fibre quality suggests that all these textiles were made from wool of similar quality, probably of local origin, possibly characterised by a short staple. In the future, additional data should be collected, especially from regions south and west of the investigated zone, to clarify the geographical and chronological extent of this tradition.

Science communication has also been an important part of the research project. In June 2024 (June 13th–16th) the festival “Hallstatt Days” was held in the municipality of Kaptol, Croatia, on the theme “Textiles of the Iron Age”. The event was organised by the Kaptol Municipality, Tourist Board Zlatni Papuk, Archaeological Museum of Zagreb, Iron Age Danube Route, Centre for Prehistoric Research and University of Zagreb, Faculty of Humanities and Social Sciences. The three-day festival had a diverse programme including a scientific conference titled “Iron Age Textiles: Stories from European Crossroads” (fig. 4, A), organised as part of the IronFoodTexMet project as well as a public engagement event. The latter included an exhibition by Karina Grömer and Kayleigh Saunderson, titled “Dressing the Past – Hallstatt Period Costume from Austria”, accompanied by a public talk on textiles in prehistoric archaeology by Julia Fileš Kramberger. The festival also involved various workshops for the public, among them one on hand-weaving (fig. 4, C), as well as a fashion show organised by Karina Grömer, Julia Fileš Kramberger,

and Kayleigh Saunderson at Kaptol’s main square. In the fashion show, titled “Catwalk to the past” members of the local community as well as researchers were dressed in costume reconstructions based on textile research from the Neolithic to the Roman period (fig. 4, B).

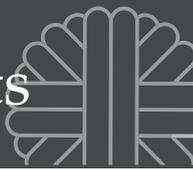
The IronFoodTexMet project has, for the first time, carried out a systematic collection of archaeological evidence related to the Iron Age textile production in the northern and central Balkans (Gleba et al., forthcoming). The quantity and the quality of the data collected to date allow us to begin filling the lacuna that until recently characterised Iron Age archaeology in the region, which was an important crossroads between the Italic-central European and Greece-Near Eastern textile cultures. Future research will hopefully allow expanding the area of investigation by adding new sites and a focus on the regional and chronological specificities.

Conclusion

The Croatian Science Foundation’s project “Creating European Identities – Food, Textiles, and Metals in the Iron Age between the Alps, Pannonia, and the Balkans” concluded in 2024. The aim of the project was to identify formative elements of the identities of Iron Age communities (among them textiles) which occupied a region that played a key role in linking three large European cultural areas: central Europe, Eastern Europe and the Mediterranean. This project gathered the first systematic collection of archaeological evidence related to Iron Age textile production in the northern and central Balkans.

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