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# An update to the La Tène plant economy in northern Serbia

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**Summary:** The archaeobotanical research of the macrobiotic remains from archaeological sites provides a valuable insight into the plant economy of the continental Celtic (Gaulish or Galatian) tribe of Scordisci, which lived around the rivers of Sava, Drava and Danube during the last three centuries before Christ. The field crop production of Scordisci was based upon cereals, grain legumes and oil crops. The importance of spelt wheat (*Triticum spelta* L.) in the everyday diets of Scordisci has been underestimated so far. Recent researches proved the presence of Byzantine oat (*Avena byzantina* K. Koch) at the Celtic tilths in the northern Balkans. Cereals were stored in mud-plastered granary baskets. The spectrum of grain legumes is as diverse as that of cereals. The latest analyses expand the list of oil plants with a new species – dragon's head (*Lallemantia iberica* (M.Bieb.) Fisch. & C.A.Mey.). There is also the first evidence of a beer production facility in one of the Scordisci oppida, Čarnok.
**Key words:** archaeobotany, beer production, Celts, *Lallemantia iberica*, *Triticum spelta*, pulses, Scordisci

## Introduction

During the 4th century BC, continental Celtic tribes, usually designated as Gauls or Galatians, began to move from their homelands in Central Europe and northern Italy to the Balkans, paying homage to Alexander the Great in 335 BC and eventually invading Greece in 279 BC (Jovanović, 2014). Following a disastrous outcome of this war expedition, one part of the Balkan Celts settled in Asia Minor, establishing their own kingdom of Galatia with its capital of Ankyra (Sims-Williams, 2020) and, three centuries later, adopting Christianity and becoming immortalised as one of the recipients of St. Paul's epistles (Vasilescu, 2019). On the other hand, another portion of Celtic warriors returned northwards, where the rivers Drava, Sava and Morava join the middle flow of the Danube (Tasić, 1992). There, they founded a cultural group usually known as Scordisci and sometimes as Scordiscae and Scordiscii, with the Celtic La Tène element prevalent and with notable linguistic impacts of Dacians, Illyrians, Thracians and other Paleo-Balkan peoples (Mihajlović, 2018). Among its important fortified settlements called *oppida* were Capedunum (Užice), Čurug, later Roman Cusum (Petrovaradin), Singidunum (Karaburma in Belgrade), Sirmium (Sremska Mitrovica), Taurunum (Zemun), Veliki Vetren on Juhor and Židovar near Vršac (Stojić & Donjon, 1999; Falileyev, 2013; Grainger, 2020), with an impressive amalgam of the Celtic and Hellenic cultures at the sites such as Kale-Krševica near Vranje (Popović, 2012) (Fig. 1).

On the territory that was roughly covered by the tribal state of Scordisci, field crops had been cultivated since the early Neolithic Starčevo culture, with cereals such as barley (*Hordeum vulgare* L.), emmer (*Triticum dicoccum* Schrank ex Schübl.) and einkorn (*Triticum monococcum* L.) present as early as 6400–6000 BC (Filipović, 2014) and with the remains of pulses such as lentil (*Lens culinaris* Medik.) and pea (*Pisum sativum* L.)

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dated back to 6th millennium BC (Medović & Mikić, 2014). Complex archaeological and linguistic analyses reveal that the main field crops of the early Celtic agriculture in Britain, Gaul and Ireland were basically and expectingly similar to that of the Balkans during the reign of the Scordisci, with the cereals like oats (*Avena* spp.), barley, emmer and bread wheat (*Triticum aestivum* L.), pulses as pea and field bean (*Vicia faba* L.) and oil and fibre plants such as rape (*Brassica* spp.) and flax (*Linum usitatissimum* L.) (Koch & Minard, 2012). Among the reconstructed Proto-Celtic roots relating to field crops are **arbīno-* (rape), **korkkyo-* (oat), **lino-* (flax), **sasyo-* (barley) and **torjVnā-* and **wo-nixto-* (wheat) (UW, 2002; Matasović, 2009), while among the attested Gaulish words denoting field crops are *arinca* (a kind of cereal; barley), *blato-* (wheat; flour), sasiam (barley) (Dottin, 1920).

Every now and then, numerous macro-botanical samples taken during the archaeological excavations in northern Serbia in the 1960s and 1970s emerge in the museum depots. These materials have never been analyzed. They contain charred seeds and fruits of cultivated crops and their accompanying weeds. One of the prominent examples of forgotten and left behind samples is the archaeological site Gomolava near Hrtkovci. On the other hand, rescue and small-scale excavations in recent years have also yielded archaeobotanical material. But, these plant assemblages are too small. They are not worth publishing on their own. And, there are also recent discoveries that can change the previous interpretation of the finds. In this paper, we will summarize all these three components. We believe to be able to significantly contribute and supplement previous knowledge of the plant economy of the continental Celtic tribe of Scordisci.

## Material and methods

A cardboard box filled with ‘charred cereals’ from Gomolava dated to the La Tène period was found in the depot of the Museum of Vojvodina. It was brought


Fig. 1. Territory of the Scordisci in 2nd/1st centuries BC with some important sites

into the Museum during the 1960s campaign. The weight of charred material is 5.5 kg. A 100 g-sample was separated through series of test sieves (3 mm, 1.5 mm and 0.355 mm) into fractions. Three test tubes with charred grains from the archaeological site Matejski Brod were found in the depot of the Museum in Zrenjanin. Seven samples dated to the Late Iron Age from the site Čurug–Stari vinogradi and one sample of the same period from Kać–Čot were also analyzed. The volume of each soil substrate was 10 l. After the flotation, dry charred material was separated through series of test sieves. The sieving residues were sorted and identified under a stereo-microscope, using magnifications of 10Í to 45Í in 2019 in the Museum of Vojvodina. Depending on the state of preservation, seeds and other botanical macro-remains could be identified to different taxonomic levels by using reference collection and identification manuals.

Thousand grain weight (TGW) of cereals and other crops were calculated upon 100 ($TGW_{100}$), or less whole, undamaged kernels; e.g. TGW from 50 ($TGW_{50}$). The calculation length/width (L/W), length/height (L/H) indices were made upon 100 ($L/W_{100}$, $L/H_{100}$), or less whole, undamaged kernels; e.g. L/W from 50 ($L/W_{50}$) L/H from 50 ($L/H_{50}$).

## Results and discussion

The main cereals of the rich old sample from Gomolava were hulled barley (*Hordeum vulgare* L. subsp. *vulgare*), spelt wheat (*Triticum spelta* L.) and broomcorn millet (*Panicum miliaceum* L.) (Table 1).

Table 1. Charred and mineralized plant items (seeds and one-seeded fruits, unless otherwise stated) from a 'forgotten' macro-botanical sample (100 g) from 1960s archaeological campaign at Gomolava, dated from La Tène period. n: quantity; n (%): quantity percentage; mg: mass in milligrams; mg (%): mass percentage; TGW (g): thousand grain weight in grams; r: < 0.5 %; +: > 0.5 % < 1.0 %

| Charred plant items | n | n (%) | mg | mg (%) | TGW (g) | *From* |
|---|---|---|---|---|---|---|
| Cereals | | | | | | |
| *Triticum spelta** | 1959 | 9.48 | 25919 | 27.59 | | |
| *Triticum* cf. spelta, fragments | 711 | 3.44 | 9134 | 9.72 | 12.85 | *100* |
| *T. spelta*, spikelet forks | 294 | 1.42 | 470 | + | 1.6 | *50* |
| *T. spelta*, terminal spikelet forks | 5 | r | 3 | r | | |
| *Hordeum vulgare* subsp. *vulgare* | 2287 | 11.07 | 30666 | 32.65 | 13.41 | *100* |
| *Triticum monococcum* | 146 | + | 1711 | 1.82 | 11.7 | *50* |
| *T. monococcum*, spikelet forks | 8 | r | 5 | r | | |
| *Triticum aestivum* s.l. | 15 | r | 156 | r | | |
| *T. aestivum* s.l., rachis internodes | 1 | r | 1 | r | | |
| *Avena* spp. | 5 | r | 29 | r | | |
| *Secale cereale* | 1 | r | 7 | r | | |
| *Triticum dicoccum* | 1 | r | 10 | r | | |
| Cerealia indeterminata, fragments | 337 | 1.63 | 3440 | 3.66 | | |
| Millets | | | | | | |
| *Panicum miliaceum* | 14652 | 70.90 | 22124 | 23.55 | 1.51 | *100* |
| Pulses | | | | | | |
| *Lens culinaris* | 7 | r | 40 | r | | |
| *Pisum sativum* | 1 | r | 6 | r | | |
| Leguminosae sativae indeterminatae | 2 | r | 13 | r | | |
| Oil plants / Medicinal plants / Potherbs | | | | | | |
| *Lallemantia iberica* | 4 | r | 4 | r | | |
| Potential medicinal plants | | | | | | |
| *Malva* sp. | 1 | r | 1 | r | | |
| *Verbena officinalis* | 1 | r | 0 | r | | |
| Fruits | | | | | | |
| *Vitis* sp. | 1 | r | 5 | r | | |
| Rosaceae | 1 | r | 1 | r | | |
| Weeds / Ruderals | | | | | | |
| *Chenopodium album* | 90 | r | 26 | r | | |
| *Chenopodium hybridum* | 26 | r | 16 | r | | |
| *Bromus arvensis* | 14 | r | 18 | r | | |
| *Agrostemma githago* | 11 | r | 31 | r | | |
| *Heliotropium europaeum* | 11 | r | 5 | r | | |
| *Bromus secalinus* | 10 | r | 31 | r | | |
| *Fallopia convolvulus* | 6 | r | 10 | r | | |
| *Schoenoplectus lacustris* | 6 | r | 3 | r | | |
| *Setaria viridis* | 6 | r | 2 | r | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| *Galium spurium* | 5 | r | 3 | r | | |
| *Stachys* sp. | 4 | r | 3 | r | | |
| *Adonis* sp. | 3 | r | 11 | r | | |
| *Lolium*, small seeded | 3 | r | 2 | r | | |
| *Solanum nigrum* | 3 | r | 1 | r | | |
| *Teucrium*-Type | 3 | r | 2 | r | | |
| *Trifolium*-Type | 3 | r | 2 | r | | |
| *Convolvulus arvensis* | 2 | r | 2 | r | | |
| *Echinochloa crus-galli* | 2 | r | 0 | r | | |
| *Plantago lanceolata* | 2 | r | 0 | r | | |
| *Coronilla varia* | 1 | r | 1 | r | | |
| *Digitaria sanguinalis* | 1 | r | 0 | r | | |
| cf. *Knautia arvensis* | 1 | r | 1 | r | | |
| *Melampyrum* cf. *arvense* | 1 | r | 4 | r | | |
| *Portulaca oleracea* | 1 | r | 0 | r | | |
| *Rumex crispus*-Type | 1 | r | 0 | r | | |
| *Silene*-Type | 1 | r | 0 | r | | |
| *Stachys* cf. *annua* | 1 | r | 0 | r | | |
| Plant families | | | | | | |
| Asteraceae | 3 | r | 1 | r | | |
| Asteraceae, involucrum | 1 | r | 9 | r | | |
| Lamiaceae | 2 | r | 0 | r | | |
| Polygonaceae | 2 | r | 1 | r | | |
| Poaceae | 1 | r | 1 | r | | |
| Sum | 20667 | 100.00 | 93931 | 100.00 | | |
| Agglutinated charred items | | | | | | |
| *Triticum spelta* x *T. spelta* (spikelet) | 3 x | | | | | |
| *T. spelta* x *T. spelta* | 3 x | | | | | |
| cf. *T. spelta* x cf. *T. monococcum* | 1 x | | | | | |
| Mineralized plant items | n | n % | mg | mg % | | |
| *Panicum miliaceum* | 1 | | 0 | | | |
| *Sambucus* sp. | 1 | | 1 | | | |
| Charred wood | n | n % | mg | mg % | | |
| Branch: | | | | | *Growth rings* | |
| *Cornus sanguinea* | 9 | | 790 | | 1 x 5 | |
| *Ulmus* sp. | 4 | | 226 | | 2 x 3, 1 x 5 | |
| *Acer* sp. | 6 | | 219 | | 1 x 1, 3 x 2 | |
| Pomoidae | 4 | | 212 | | 1 x 4, 1 x 6 | |
| *Fraxinus* sp. | 2 | | 96 | | 2 x 1, 1 x 2 | |
| *Quercus* sp. | 2 | | 37 | | 2 x 2 | |
| Coniferae (*Abies/Juniperus/Taxus*) | 1 | | 5 | | 1 x 1 | |
| Stemwood: | | | | | | |
| *Quercus* sp. | 8 | | 310 | | | |
| *Prunus* sp. | 2 | | 70 | | | |
| *Acer* sp. | 1 | | 14 | | | |
| Dicotyledon wood, fragments | x | | 1300 | | | |
| **Triticum spelta* separated by form types: | n | n % | mg | mg % | TGW (g) | *From* |
| *Triticum spelta*, oblong/elliptic | 936 | 47.78 | 12276 | 47.36 | 13.12 | *100* |
| *T. spelta*, elliptic | 681 | 34.76 | 9547 | 36.83 | 14.02 | *100* |
| *T. spelta*, obovate/truncate | 208 | 10.62 | 2905 | 11.21 | 13.96 | *50* |
| *T. spelta*, ovate | 26 | 1.33 | 304 | 1.17 | 11.81 | *16* |
| *T. spelta*, lateral view - convex | 80 | 4.08 | 799 | 3.08 | 9.93 | *15* |
| *T. spelta,* stunted small | 24 | 1.23 | 79 | r | 3.33 | *9* |
| *T. spelta,* stunted long | 4 | r | 9 | r | | |
| Sum | 1959 | 100.00 | 25919 | 100.00 | | |

Macro-botanical analyses published in the new millennium (Kišgeci & Medović, 2006; Medović, 2002; van Zeist, 2002) made an impression that naked wheat was dominant among hexaploid species of wheat during the La Tène period in the southern part of the Pannonian Plain. Judging from rediscovered and recently analyzed old samples in the Museum of Vojvodina and Zrenjanin, and other small scale excavations in the region, spelt wheat was of great importance in that period. This coincides with the results of other research in the region (Dálnoki & Jacomet, 2002).

The identification of spelt wheat is difficult because the spelt grains assume very different shapes after carbonisation, depending on whether the grains were carbonised with their glumes or without them (Dálnoki & Jacomet, 2002). Previously, it was believed that ”typical” spelt grains have “parallel sides”. But, there were also observed emmer-like grains among *T. spelta* grains in Budapest. They are approximately drop-shaped but too flat and too large for emmer (Dálnoki & Jacomet, 2002). Also, there were grains with a convex ventral side. They come from single-grained spikelets. Among spelt grains, some ‘stunted’ grains were also observed in the archaeobotanical samples in the region (Reed et al., 2019). They are half the size of the other grains but are almost fully formed with the typical morphological shape of *T. spelta*.

In the archaeobotanical assemblage from Gomolava, we distinguish seven different shape types. Four shapes refer to planar shapes. The term oblong/elliptic refers to grains with “parallel sides” and/or grains with slightly curved sides (e.g. narrowly elliptic) (Fig. 2). This shape is the most common. Almost half of the grains belong to this category.

More than one-third of all grains are elliptic grains, with Length/Width (L/W) ratio from 2:1 to 1.5:1 (Fig. 3). More than 10 per cent of all *T. spelta* grains are obovate, or „drop-shaped“ (L/W 2:1–1.5:1) with truncate apex (Fig. 4).

Only 1.33 per cent of all grains have curved sides and are widest at the base – ovate (L/W 2:1–1.5:1) (Fig. 5). They are most similar to *T. aestivum* grains (Fig. 5). Ovate spelt grains are distinguishable from naked wheat by the shape of the ventral furrow and the position of the embryo. The round embryo of naked wheat grains lies deep in the cavity. Their ventral furrow is wide and deep. In contrast, spelt wheat grains have narrow ventral furrow and the position of the embryo is not in the cavity.

There are also grains with a convex ventral side (grains from single-grained spikelets). They make 4% of all spelt finds (Fig. 7). Stunted grains belong to a new category proposed by Reed et. al. (Reed et al., 2019). We distinguish smaller and longer groups of these fully developed but atrophied grains (Fig. 8, 9). They make more than 1% of all spelt finds.

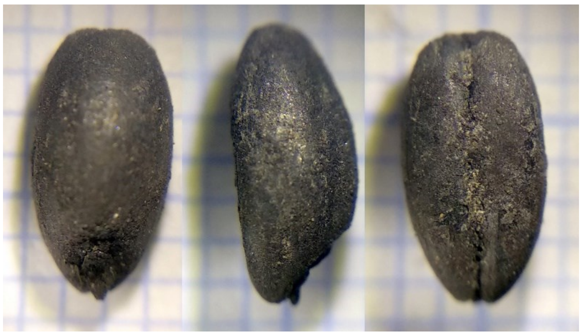

Fig. 2. Oblong/elliptic *Triticum spelta* grain from La Tène Gomolava sample. Photo: A. Medović

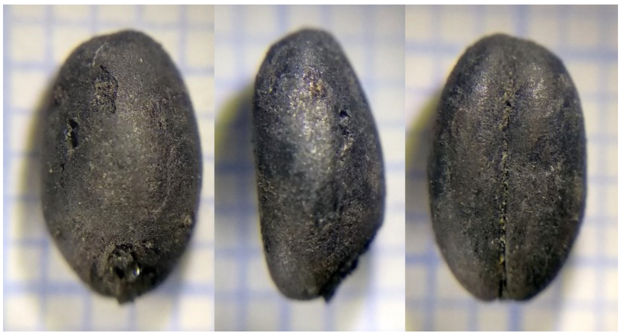

Fig. 3. Elliptic *T. spelta* grain from La Tène Gomolava sample. Photo. A. Medović

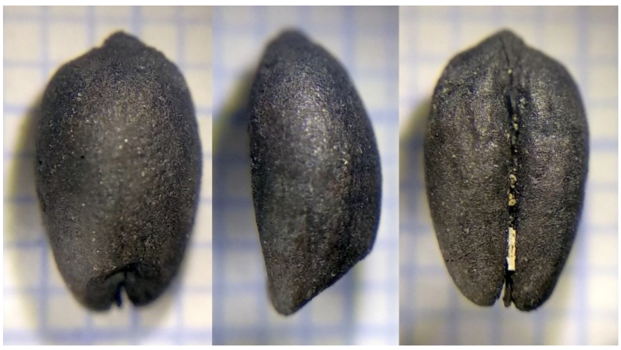

Fig. 4. “Drop-shaped” *T. spelta* grain from La Tène Gomolava sample. Photo A. Medović

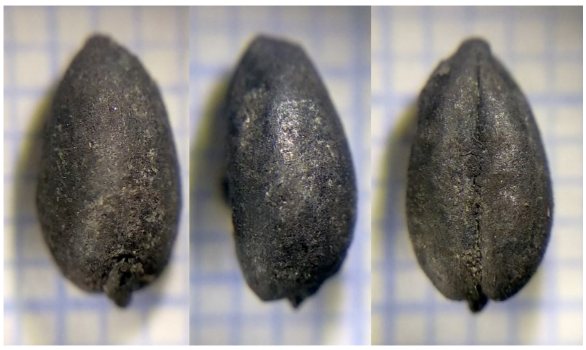

Fig. 5. Ovate *T. spelta* grain from La Tène Gomolava sample. Photo A. Medović

Thousand grain weight (TGW) of three spelt wheat categories were calculated. Elliptic grains are the heaviest ($TGW_{100}$ = 14.02 g), followed by obovate/ truncate grains ($TGW_{50}$ = 13.96 g) and oblong/elliptic ($TGW_{100}$ = 13.12 g). Hundred of randomly picked, unseparated whole spelt wheat grains were weighed to obtain TGW for the calculation of spelt wheat fragments. Interestingly, this TGW was only 12.85 g (see Table 1).

The L/W ratio among 100 "typical" grains ($L/W_{100}$) from Gomolava sample is 2.3 and by all other categories, this value lies below 2: elliptic grains ($L/W_{100}$= 1.71), "drop-shaped" grains ($L/W_{50}$= 1.71), ovate grains ($L/W_{16}$= 1.79), stunted grains ($L/W_{9}$ = 1.71), grains with a convex ventral side ($L/W_{15}$=1.86). This still fits in with previous experiences from other archaeological sites; their L/W ratio is around 2 (1.5–2.45) (Jacomet, 2006).

But, spelt grains from Gomolava are on average higher than those of spelt grains from other sites (Jacomet, 2006). The Leingth/Height (L/H) values of spelt wheat from Gomolava sample coincides more with those of emmer (1.9–2.5; mostly around 2.3): 'typical' grains from Gomolava sample ($L/H_{100}$= 2.35), elliptic grains ($L/H_{100}$= 2.04), 'drop-shaped' grains ($L/H_{50}$= 2.04), ovate grains ($L/H_{16}$= 2.07), stunted grains ($L/H_{9}$= 2.21), grains with a convex ventral side ($L/H_{15}$= 1.83). No spikelet forks of emmer were found in the sample from Gomolava. Only a single, easily recognizable emmer grain ('crooked', 'hump-backed' and with concave ventral side) could be identified (Jacomet, 2006; Kroll & Reed, 2016) (Fig. 10). In contrast, 294 typical spikelets (Jacomet, 2006) and 5 terminal spikelets from spelt wheat (Medović, 2009) were singled out. Spelt grains, particularly when they were charred enclosed within glumes, can have a very similar shape to emmer (Dálnoki & Jacomet, 2002; Jacomet, 2006). In the sample from Gomolava, at least, the half of the spelt grains were carbonized while still enclosed within glumes.

The composition of charred wood singled out during the analyses indicates that the cereals were stored in mud-plastered granary-baskets, which has been the case at Čarnok (Medović, 2011, 2006). The majority of wood consisted of young branches of seven different taxa, ranging from one to six years old (Table 1).

At Matejski Brod, a well known late Neolithic site, during the excavations in the second half of the 20th century, charred cereal grains were collected from an oven and stored in three small test tubes. At first, the find was relatively dated into the Late Neolithic by the archaeologists. Macrobotanical analyses revealed that 80% of find belongs to spelt grains (Table 2). The rest consisted of einkorn, emmer and barley grains. The Radioactive Carbon (14C) Analyses has shifted the date to the 4th/3rd century BC (375–203 cal BC). Fifty whole grains were used to determine the thousand-grain weight (TGW). It is low (9.08 g), but not as low as spelt grains from 4th cent. AD at Čurug (7.89 g), so-called 'Grünkern' or 'Pražma' (Medović, 2009). The ratios of the spelt that has been harvested when half-ripe and then artificially dried were 1.77 (L/W) and 2.14 (L/H).

Fig. 6. *Triticum aestivum* grain from La Tène Gomolava sample. Photo A. Medović

Fig. 7. *T. spelta* grain with a convex ventral side from La Tène Gomolava sample. Photo A. Medović


Fig. 8. Stunted *T. spelta* grains from La Tène Gomolava sample: a) "small", b) "long". Photo A. Medović

Fig. 9. Comparison between normal and stunted *T. spelta* grain. Photo A. Medović

Fig. 10. Single 'typical' *Triticum dicoccum* grain from La Tène Gomolava sample. Photo A. Medović

Table 2. Charred plant items (seeds and one-seeded fruits, unless otherwise stated) from Matejski Brod, dated from La Tène period. n: quantity; n (%): quantity percentage; mg: mass in milligrams; mg (%): mass percentage; r: < 0,5 %; +: > 0,5 % < 1,0 %

| Charred plant items | n | n (%) | mg | mg (%) |
|---|---|---|---|---|
| *Triticum spelta* | 391 | 79.63 | 2864 | 81.39 |
| *T. spelta,* spikelet forks | 1 | r | 2 | r |
| *Triticum monococcum* | 19 | 3.87 | 123 | 3.50 |
| *Triticum dicoccum* | 14 | 2.85 | 102 | 2.90 |
| *Hordeum vulgare vulgare* | 8 | 1.63 | 60 | 1.71 |
| *Triticum* spp. | 2 | r | 5 | r |
| Cerealia indeterminata | 55 | 11.20 | 363 | 10.32 |
| *Chenopodium* sp. | 1 | r | 0 | r |
| Sum | 491 | 100 | 3519 | 100 |
| Other charred finds | | | | |
| *Phragmites communis*, stem fragments | 1 | | 4 | |
| Agglutinated charred items | | | | |
| *Triticum spelta* x *T. spelta* (spikelet) | 1 x | | | |

A comparison of ratios (L/W and L/H ratio) between spelt grains from Gomolava and other spelt finds in the region is possible to a certain extent. Until 2002 (Dálnoki & Jacomet, 2002) and even later only grains with 'parallel sides' and/or without any characteristics were identified as spelt wheat. The conservative identification criteria certainly led to an increase in the number of Cerealia indeterminata finds, but also of *Triticum aestivum* and/or *T. aestivum/spelta* finds, e.g. (van Zeist, 2002, Fig. 3c). Therefore, we can only compare ratios of "typical" spelt grains. The L/H and L/W values of spelt grains at the Bronze/Iron Age site Feudvar were school-like, around 2,5 and 2 (Kroll & Reed, 2016). The L/H ratio of spelt grains from the late Bronze Age Stillfried is 2.36 (Kohler-Schneider, 2001), as "typical" grains from Gomolava sample.

During the excavation of the archaeological site Kać –Čot which is situated nearby experimental fields of the Institute of Field and Vegetable Crops at Rimski Šančevi, one sample from the Late Iron Age contained as many spelt grains as naked wheat (Table 3).

Among other oil plants during La Tène period in Serbia, flax (*Linum usitatissimum* L.), gold of pleasure (*Camelina sativa* (L.) Crantz.), opium poppy (*Papaver somniferum* L.), there is evidence of a new cultivated plant – dragon's head (*Lallemantia iberica* (M.Bieb.) Fisch. & C.A.Mey.). Hemp (*Cannabis sativa* L.) which was found in the La Tène layers of archaeological sites in the region (Dálnoki & Jacomet, 2002) fulfil the oil plant spectra.

Four charred seeds of the dragon's head were identified in a newly found old sample from Gomolava (Fig. 11). This is the first evidence of the oil plant in the La Tène layers in Serbia. Macro-botanical remains of the dragon's head first appeared in Europe in northern Greece in the Early Bronze Age (Jones & Valamoti, 2005). This indicates long-distance contacts with communities to the east at this time. The species name *iberica* may be misleading. The plant has nothing to do with Spain and the Iberian Peninsula. Iberia is a country south of the Caucasus Mountains, today's East Georgia. The seeds of *L. iberica* have been identified at two archaeological sites in northern Serbia. They have been found in the Middle Early Bronze Age and Iron Age layers at Feudvar (Kroll & Reed, 2016) and in the Middle Bronze Age layers at Židovar (Kišgeci & Medović, 2006). Charred seeds of dragon's head were also found at the Late Bronze Age Hissar in the southeast of Serbia (Medović, 2012).

Table 3. Charred and mineralized plant items (seeds and one-seeded fruits, unless otherwise stated) from archaeological sites of Čurug–Stari vinogradi and Kać–Čot, dated from La Tène period. n: quantity

| Archaeological site | Čurug | Kać-Čot |
|---|---|---|
| Number of samples analyzed | 7 | 1 |
| Charred plant items | n | n |
| Cereals | | |
| *Avena* spp. | 67 | 0 |
| *Triticum aestivum* s.l. | 53 | 49 |
| *T. aestivum*, rachis internodes | 2 | 0 |
| *Triticum monococcum* | 49 | 32 |
| *T. monococcum*, spikelt forks | 13 | 2 |
| *Triticum spelta* | 2 | 44 |
| *Triticum spelta*, spikelet forks | 1 | 3 |
| *Hordeum vulgare* | 26 | 26 |
| *Hordeum*, rachis internodes | 1 | 0 |
| *Triticum dicoccum* | 10 | 2 |
| *Triticum* spp. | 3 | 3 |
| *Triticum,* spikelt forks | 0 | 1 |
| Cerealia indeterminata | 159 | 115 |
| Millets | | |
| *Panicum milaceum* | 399 | 35 |
| *Setaria italica* | 1 | 0 |
| Pulses | | |
| Leguminosae sativae indeterminatae | 0 | 1 |
| Fruits | | |
| *cf.* Trapa natans | 1 | 0 |
| Possible medicinal plants | | |
| *Verbena officinalis* | 1 | 2 |
| Weeds/Ruderals | | |
| *Chenopodium album* | 83 | 22 |
| *Digitaria sanguinalis* | 18 | 0 |
| *Solanum nigrum* | 8 | 0 |
| *Setaria viridis* | 6 | 0 |
| *Bromus arvensis* | 5 | 0 |
| *Stipa* sp., awn fragments | 5 | 0 |
| *Agrostemma githago* | 4 | 0 |
| *Echinochloa crus-galli* | 4 | 0 |
| *Fallopia convolvulus* | 4 | 0 |
| *Chenopodium* sp. | 1 | 0 |
| *Bromus secalinus* | 3 | 0 |
| *Dasypirum villosum* | 3 | 0 |
| *Myosotis* sp. | 3 | 0 |
| *Trifolium*-type | 2 | 1 |
| *Galium spurium* | 2 | 0 |
| *Verbascum* sp. | 2 | 0 |
| *Lithospermum arvense* | 1 | 0 |
| *Bromus* sp. | 0 | 1 |
| *Centaurea* sp. | 1 | 0 |
| *Vicia* sp. | 0 | 1 |
| Plant families | | |
| Poaceae | 17 | 1 |
| Lamiaceae | 0 | 1 |
| Sum | 960 | 342 |
| Charred wood et similis | | |
| *Phragmites communis*, stem fragments | 6 | 3 |
| *Quercus* sp. | 0 | 11 |
| *Euonymus europaeus* | 0 | 2 |
| Pomoidae, branch | 0 | 2 |
| Mineralized plant items | | |
| *Sambucus ebulus* | 6 | 1 |
| *Sambucus* sp. | 1 | 0 |
| *Chenopodium album* | 1 | 1 |
| Insecta | | |
| Coleoptera, imago | 1 | 0 |

Fig. 11. *Lallemantia iberica* (M.Bieb.) Fisch. & C.A.Mey. Recent (Archaeobotanical Garden of the Museum of Vojvodina) and charred seeds (Gomolava, La Tène period). Photo: A. Medović

It was suggested that in the Bronze Age the dragon's head was grown and stored for oil (Jones & Valamoti, 2005). But, all parts of dragon's head have economic uses: leaf for extraction of essential oils, as a vegetable and potherb, seed for extraction of mucilage and edible or industrial oil. Dragon's head is a valuable species whose seeds contain 26–40% oil with high iodine index 162.2–202.9 and very dry, in this regard surpassing the linseed oil (Ursu & Borcean, 2012). The vegetation period is between 70 and 80 days. The minimum germination temperature is 3–5°C and the young plants can bear temperature up to minus 7–8°C, if such low temperatures do not last a long time. Dragon's head is not very sensitive to heat. Regarding the soil, the plant has few requirements; the best results are obtained on chernozem-type soils. The humidity requirements are moderate. Excess humidity makes the plans more sensitive to diseases. This is probably why attempts to cultivate the plant and extract oil from the seeds did not have the desired success in Western Europe. The plant was reintroduced into Europe again after it was shown at the Persian pavilion at Vienna World Exhibition in 1873, but only in southern Russia, the Caucasus, and other areas on the Black and Caspian Seas (Steger & van Loon, 1944).

The first find of Byzantine oat (*Avena byzantina* K. Koch) was discovered in one of the old cardboard boxes (Medović, 2013) from Gomolava and was reconfirmed by another newly analysed smaller sample (Table 4), the content of a smaller clay vessel, so called Kantharos (Fig. 12). Seven samples from the Late Iron Age period at Čurug–Stari Vinogradi contained a large amount of *Avena* grains (Table 3). No floret bases (Fig. 13), which could confidently have been identified to the species level, were found. But, according to the number of the finds (after *Panicum miliaceum* L. second most numerous), it can be assumed to belong to cultivated oat.

Fig. 12. Clay vessel from Gomolava (kantharos) which contained Byzantine oat grains (*Avena byzantina* K. Koch). Photo: A. Medović

There is an evidence of the first beer production facility in present-day Serbia. Two separate finds from Europe (Larsson et al., 2018; Stika, 2011, 1996) made us reconsider the previous interpretation of house 5 context at the Oppidum Čarnok (Medović, 2011, 2006): the house was probably used for beer production. It has all the necessary brewing equipment (Fig. 14): a long wooden container field with barley grains with a basket full of barley grains placed on the wooden container, a low-temperature kiln structure and numerous clay pots. The reconstruction of a beer-making might have looked like this: As a pre-treatment for beer brewing, germination of barley was induced intentionally in the process to make malt by wetting the grain in the wooden container. A low-temperature kiln was used to stop the germination process by drying or roasting the grain. It can be inferred that a wooden container was probably used also for mashing the dissolved malt into a pulp. None of the barley grains found in a basket and wooden container started to

Table 4. Charred and mineralized plant items (seeds and one-seeded fruits, unless otherwise stated) from another 'forgotten' macro-botanical sample (the content of a clay vessel) from 1960s archaeological campaign at Gomolava, dated from La Tène period. n: quantity; n (%): quantity percentage; mg: mass in milligrams; mg (%): mass percentage; TGW (g): thousand grain weight in grams; r: < 0.5 %; +: > 0.5 % < 1.0 %

| Charred plant items | n | n (%) | mg | mg (%) | TGW (g) | *From* |
|---|---|---|---|---|---|---|
| Cereals | | | | | | |
| *Avena* spp. | 385 | 38.01 | 2489 | 55.42 | 6.47 | 100 |
| *Avena* sp., *glumes* | 37 | 3.65 | 32 | + | | |
| *Avena byzantina*, 1. grain + primary floret bases | 2 | r | 15 | r | | |
| *A. byzantina*, 2. grain + secondary floret bases | 3 | r | 21 | r | | |
| *A. byzantina*, primary floret bases | 33 | 3.26 | 36 | + | | |
| *A. byzantina*, secondary floret bases | 23 | 2.27 | 1 | r | | |
| *Triticum spelta* | 55 | 5.43 | 600 | 13.36 | | |
| *T. spelta*, spikelet forks | 25 | 2.47 | 36 | + | | |
| *T. spelta*, ear fragments | 3 | r | 2 | r | | |
| *Triticum dicoccum* | 14 | 1.38 | 178 | 3.96 | | |
| *T. dicoccum,* from single-grained spikelet | 2 | r | 19 | r | | |
| *T. dicoccum, spikelet forks* | 6 | + | 8 | r | | |
| *Triticum monococcum* | 8 | + | 81 | 1.80 | | |
| *T. monococcum,*spikelet forks | 9 | + | 8 | r | | |
| *Hordeum vulgare vulgare* | 3 | r | 21 | r | | |
| Cerealia indeterminata | 16 | 1.58 | 177 | 3.94 | | |
| Millets | | | | | | |
| *Panicum miliaceum* | 331 | 32.68 | 480 | 10.69 | 1.45 | 50 |
| Pulses | | | | | | |
| *Lens culinaris* | 1 | r | 2 | r | | |
| Oil/fibre plants | | | | | | |
| *Camelina sativa* | 2 | r | 0 | r | | |
| Weeds/Ruderals | | | | | | |
| *Chenopodium album* | 14 | 1.38 | 3 | r | | |
| *Bromus arvensis* | 3 | r | 4 | r | | |
| *Convolvulus arvensis* | 3 | r | 6 | r | | |
| *Setaria viridis* | 3 | r | 1 | r | | |
| *Bromus secalinus* | 2 | r | 6 | r | | |
| *Chenopodium hybridum* | 1 | r | 0 | r | | |
| *Galium spurium* | 1 | r | 1 | r | | |
| *Heliotropium europaeum* | 1 | r | 0 | r | | |
| *Solanum nigrum* | 1 | r | 0 | r | | |
| 'Porridge' | 26 | 2.57 | 264 | 5.88 | | |
| Sum | 1013 | 100 | 4491 | 100 | | |
| Agglutinated charred items | | | | | | |
| *Panicum miliaceum x P. miliaceum* | 4x | | | | | |
| Mineralized plant items | | | | | | |
| *Chenopodium album* | 1 | | 0 | | | |
| Charred wood | | | | | | |
| *Quercus* sp. | 2 | | 7 | | | |
| *Salix/Populus* | 3 | | 7 | | | |

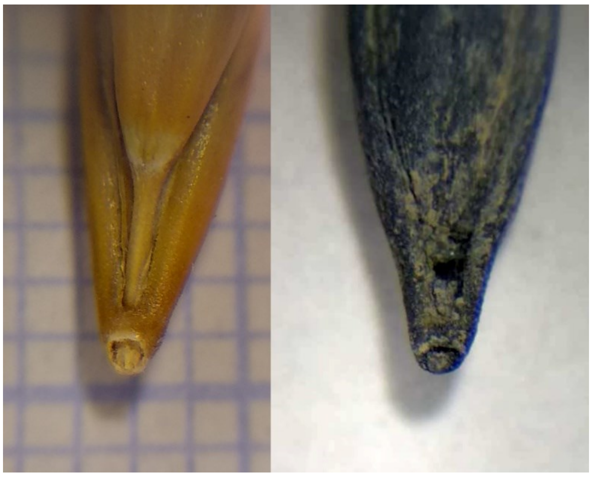

Fig. 13. *Avena byzantina* C. Koch. Primary floret bases with small 'sucker mouth': recent (Archaeobotanical Garden of the Museum of Vojvodina) and charred (Gomolava, La Tène period). Photo: A. Medović

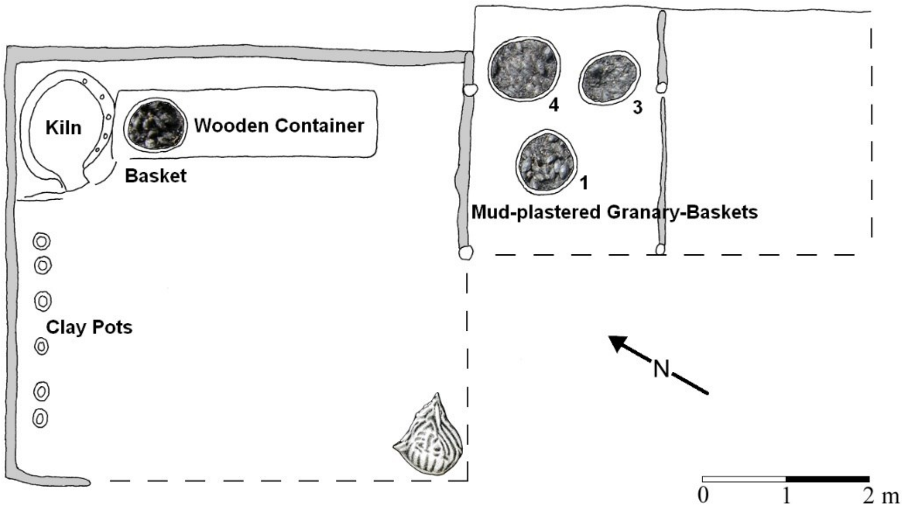


Fig. 14. 'Beer-house' at oppidum Čarnok. Drawing: A. Medović.

sprout. Therefore, we believe that the "beer-house" started fire and burned down at the very begining of the beer production process.

Charred mericarps of common heliotrope (*Heliotropium europaeum* L.) has their first occurrence in the archaeobotanical assemblages in Serbia so far. This is a herbaceous Mediterranean summer annual that grows on areas devoid of vegetation in the dry-land cropping region. Its presence in both La Tène samples from Gomolava can be interpreted as a weedy novelty from the unsuccessful Celtic Greece campaign. *H. europaeum* is one of the most prevalent species being previously reported to be implicated in numerous poisoning events in humans and livestock worldwide (Shimshoni et al., 2015).

## Conclusions

Spelt wheat played a more important role in cereal production of the Scordiscii tribe as previously thought. Spelt wheat grains were stored enclosed within glumes in mud-plastered granary baskets. The new plant at the Celtic tilths in the northern Balkans is Byzantine oat. It was introduced to nowadays north Serbia from Greece. Common heliotrope was also introduced from Greece in the same period. Dragon's head is one of the oil plants that were introduced in the Balkans in the early Bronze Age. It was still cultivated in the Late Iron Age. There is indisputable evidence for the existence of a facility for beer brewing at an oppidum.

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# Nove informacije o biljnoj privredi Kelta u severnoj Srbiji

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**Sažetak:** Arheobotanička istraživanja makrobiljnih ostataka na arheološkim lokalitetima pružaju uvid u biljnu privredu keltskog kontinentalnog (galskog ili galatskog) plemena Skordiska koje je poslednja tri veka pre nove ere živelo na prostoru oko reka Save, Drave i Dunava. Ratarstvo Skordiska se zasnivalo na proizvodnji žitarica, zrnastih mahunarki i uljarica. U najvećoj meri uzgajali su ječam, proso, jednozrnu pšenicu, golozrnu i dvozrnu pšenicu. Do sada je bio potcenjen značaj krupnika u ratarskoj proizvodnji ovog plemena. Novija istraživanja su po prvi put dokazala postojanje vizantijskog ovsa na keltskim oranicama u severnom delu Balkana. Uz ovu novu kulturu Kelti su sa svog neuspelog pohoda na Grčku poneli i korovsku biljku koja se u našim krajevima pojavljuje po prvi put — obični posunac. Žitarice su čuvane u silosima od pletera oblepljenog blatom. Inventar zrnastih mahunarki ne zaostaje po brojnosti u odnosu na žitarice. Uzgajaju se sočivo, grašak, sastrica, bob i urov. Lan je glavna uljarica, dok se sitna semena maka i lanika retko pronalaze. Najnovija, do sada neobjavljena istraživanja zaboravljenog uzorka iz 60-ih godina pršlog veka sa arheološkog lokaliteta Gomolava, dokazuju prisustvo još jedne uljarice u naseljima Skordiska — lalemancije. Na osnovu novih saznanja na drugim arheološkim istraživanjima uspeli smo da identifikujemo prvu pivaru na tlu Srbije u keltskom opidumu Čarnok.
**Ključne reči**: arheobotanika, Kelti, mahunarke, uljarice, žitarice, pivara, krupnik, vizantijski ovas