

Joanna Abramów

DOI: 10.15584/anarres.2021.16.4

Usługi Archeologiczne i Archeobotaniczne, Młodych Av. 4/6, 41-106 Siemianowice Śląskie, Poland;
e-mail: joanna.abramow@wp.pl; ORCID: 0000-0002-9698-4627

Archaeobotanical Macroscopic Plant Remains from the Early Neolithic Dwelling Structures at the Brzezcie 40, Targowisko 16 and 14–15 Sites in Western Małopolska

Abstract

Abramów W. 2021. Archaeobotanical Macroscopic Plant Remains from the Early Neolithic Dwelling Structures at the Brzezcie 40, Targowisko 16 and 14–15 Sites in Western Małopolska. *Analecta Archaeologica Ressoiviensia* 16, 63–72.

The aim of this short article is to present the results of archaeobotanical analysis of macroscopic plant remains obtained in 2018–2019, during the test excavations carried out on three selected sites from Targowisko settlement region (Brzezcie 40, Targowisko 16 and 14–15). Thanks to the field research strategy adopted, chronologically compact plant remains were obtained from objects included in the house structures, coming from narrow time horizons, equal to the operation time of individual Linienbandkeramik houses from the beginning of the *Želiezovce* phase (Brzezcie 40 and Targowisko 16) and the phase of the classic Malice culture (Targowisko 14–15).

Keywords: LBK, Malice culture, macroscopic plant remains, early Neolithic, Targowisko region, SE Poland

Received: 29.09.2021; **Revised:** 08.10.2021; **Accepted:** 16.11.2021

Introduction

The archaeobotanical macroremains came from archaeological excavations carried out in the area of early Neolithic archaeological sites, located in Brzezcie (site 40), Targowisko (site 16 and site 14–15) commune of Klaj in the Małopolskie Voivodeship (Kadrow *et al.* 2021). Between the years 2002–2007, extensive rescue excavations related to the construction of the A-4 motorway were carried out in the area of these villages. During their implementation, the remains of an early Neolithic settlement complex related to the *Linienbandkeramik* (hereafter: LBK) and the Malicka culture (hereafter: MC) were uncovered (Golański *et al.* 2021).

In 2018–2019 test excavations were carried out on three selected sites from this region, the purpose of which was to achieve several goals. One of them was the detection of such fragments of Neolithic settlement zones where only one construction phase

has survived, in order to obtain material for archaeobotanical analysis from the shortest possible time periods related to the functioning of one house. Detection of settlement zones was performed a year earlier (2017) using a magnetometer as part of a slightly wider program of geomagnetic prospection (Golański *et al.* 2019).

It also should be mentioned that archaeological research has been carried out in the area of Targowisko in the past. From 2000, archaeological rescue excavations were conducted at archaeological sites no. 10, 11, 12 and 13 for the next eleven years. Such long term excavations were connected with the A-4 motorway project (Górski and Konieczny 2014, 7). During this period, a large multicultural settlement complex was revealed. Among the thousands of archaeological features, early Neolithic settlement traces were unearthed (Górski and Konieczny 2014, 11). Hundreds of soil samples were analysed from the Targowisko 10–11 archaeological site and, thanks to this research,

the remains of crops and other plants connected with LBK and MC culture were revealed (Lityńska-Zajac *et al.* 2014).

The subject of the analysis and the basis of this article were organic materials from three archaeological sites: Brzezie 40, Targowisko 16 and Targowisko 14–15.

Material and methods

During above-mentioned test excavation, soil samples were collected and then processed on the spot by archaeologists. The selected and already dry materials were then delivered for analysis.

A total of 275 samples were analysed and the number of samples were different for each archaeological site. From Brzezie 40 there were 87 samples, 114 samples were received from Targowisko 16 and from the Targowisko 14–15 site, 74 samples were analysed. Not all of the samples contained plant remains. All details are described in the further part of this paper.

When determining plant material (macroscopic plant remains), the keys available in the literature on the subject were used (Kowal 1953; Marek 1954; Mądalski 1957; 1965; 1967; Tymrakiewicz 1962; Katz *et al.* 1965; Kulpa 1988; Skrzypczak *et al.* 2000; Cappers *et al.* 2006; Jacomet 2006; Neef *et al.* 2012; Cappers and Bekker 2013). The selected macroremains were also compared with the comparative collection collected by Joanna Abramów's Archaeological and Archaeobotanical Services in Siemianowice Śląskie, where all of the analysed materials from Brzezie and Targowiska are held.

Latin names were given after Mirek *et al.* 2002. English names were given after Anioł-Kwiatkowska 2003.

The research material was analysed using an Olympus SZ61 stereoscopic reflected light microscope, using the magnification range from 10x to 100x.

Material analysis

As mentioned above, 275 samples were analysed. For archaeological site Brzezie 40 samples were collected from 18 objects (archaeological features). From Targowisko 16 samples obtained from 64 objects. In case of archaeological site Targowisko 14–15, samples came from 29 objects. All samples contained dry mineral residue, mainly sand, and some of them had visible diaspors. The volume of the sample never reached more than 5 ml.

During analyses, we found out that some samples only contained mineral residue without any diaspors,

while in some other case the samples contained only modern plant remains.

It should be noted that the selected plant remains were preserved in a rather poor condition. The significant structural losses made it difficult to precisely define the species, hence some of the designations are uncertain (“cf” before the species name). Because all three archaeological sites belong to the category of so-called “dry sites”, so only the charred remains can be considered equal to the archaeological site under study (Lityńska-Zajac and Wasylkowa 2005, 50). This is why the tables in this article only present those samples which contained charred plant remains.

Brzezie 40 site

As mentioned above, from this archaeological site 87 samples were analysed. As a result of microscopic observations, a total of 859 diaspors were obtained from 69 samples. In the case of 18 samples, no plant remains were found. On the basis of the analysis, a list of 17 taxa was compiled. Among them, 8 plant species were identified. Five taxa were assigned to the genus level. Three taxa were assigned to the rank of family (Tab. 1). Registered plant remains were preserved in the form of uncharred and charred specimens. As mentioned above uncharred specimens should be treated as younger material than the studied objects.

In the analysed material, the share of charred remains amounted to 11% (96 charred specimens). The vast majority, 89% (763 specimens), were uncharred and belonged to plants that were both segetal and ruderal weeds. Among the 96 burnt specimens, the remains of wild herbaceous plants and single specimens of crops – cereals were found (Tab. 6).

Charred macroscopic remains were recorded in 21 samples from seven objects: 2 (sample no. 13), 5 (sample no. 21), 7 (samples no. 24, 25, 28–30, 34, 35, 38, 41), 8B (samples no. 46, 47, 49), 10 (samples no. 60, 61), 10A (samples no. 85, 93) and from object 14 (samples no. 103–105) (Tab. 2). Among the charred remains, as already mentioned, single specimens of crops – cereals and numerous diaspors of wild herbaceous plants were identified. The share of arable crops was 6%. The remains of herbaceous plants accounted for 83%. The percentage of indeterminate specimens was 11%. It should be noted that the selected plant remains were preserved in a rather poor condition. Significant structural losses made it difficult to precisely define the species, hence some of the designations are uncertain (“cf.” before the species name).

Table 1. Brzezie, site 40, Kłaj commune, Małopolskie voivodeship. List of taxa recognized in the research material (all samples).

Key: uch – uncharred; ch – charred

Taxa name	State of preservation	Number of specimens	Number of samples
<i>Triticum</i> sp.	ch	1	1
<i>Cerealia</i> indet.	ch	5	5
<i>Chenopodium album</i>	ch	59	9
<i>Chenopodium album</i>	uch	592	61
<i>Fallopia convolvulus</i>	ch	2	2
<i>Fallopia convolvulus</i>	uch	48	32
cf. <i>Melandrium album</i>	uch	1	1
<i>Polygonum aviculare</i>	uch	20	10
<i>Rumex acetosa</i>	ch	8	6
<i>Rumex acetosa</i>	uch	3	3
<i>Setaria pumila</i>	uch	1	1
<i>Stellaria graminea</i>	uch	2	1
<i>Viola arvensis</i>	uch	1	1
<i>Atriplex</i> sp.	uch	1	1
<i>Bromus</i> sp.	ch	3	2
<i>Chenopodium</i> sp.	uch	3	2
Poaceae indet.	ch	6	2
Poaceae indet.	uch	23	5
Polygonaceae	ch	1	1
<i>Betula pendula</i>	uch	61	10
<i>Betula</i> sp.	uch	8	3
Indeterminate	uch	8	4
Indeterminate	ch	2	2
Total number 859			-

Crops

Among the 6 plant remains included in this group, cereal grains were found. Unfortunately, due to the very poor state of preservation, only one fragmentarily preserved kernel was referred to as wheat (*Triticum* sp.). The remaining grain fragments were included only in undefined cereals (*Cerealia* indet.). The presence of wheat (*Triticum* sp.) was found in the sample from object no. 14. However, the remains of single grain kernels (*Cerealia* indet.) were found in objects: 5, 7, 8B and 14.

Wild herbaceous plants

A large group of charred remains were those belonging to herbaceous, wild plants, occupying two types of habitats. The species belonging to the weeds of agricultural fields (segetal) and ruderal habitats were identified. A total of 80 specimens were recorded, which accounted for 83% of the charred remains.

Such a high proportion of herbaceous plants was influenced by fat-hen seeds (*Chenopodium album*), 59 of which were registered in total in 9 samples from three objects. The highest number of seeds was found in samples no. 24 and 25 from object 7 – a total of 39 specimens. It is interesting that in the case of samples from object no. 7, among 56 charred remains, only one fragment of an undefined grain was found (*Cerealia* indet.), while the remaining ones belonged to wild herbaceous plants: fat-hen (*Chenopodium album*), black- bindweed (*Fallopia convolvulus*) and grasses family (Poaceae indet.).

Moreover, in the research material from the Brzezie 40 site, single specimens of brome grass (*Bromus* sp.), black-bindweed (*Fallopia convolvulus*), common sorrel (*Rumex acetosa*) and probably white campion (cf. *Melandrium album*) were recorded.

The analysed material also contained kernel fragments, which due to their state of preservation were

Table 2. Brzezie, site 40, Kłaj commune, Małopolskie voivodeship. List of selected samples containing charred macroscopic plant remains.

Key: uch – uncharred; ch – charred; g – grain; f – fragments; n – nutlets; sh – seed hulls; s – seed; un – undefined

Taxa name	State of preservation and kind of remains	Sample number																				
		13	21	24	25	28	29	30	34	35	38	41	46	47	49	60	61	85	93	103	104	105
<i>Triticum</i> sp.	ch; f, g																					1
<i>Cerealia</i> indet.	ch; f, g		1					1						1							1	1
<i>Chenopodium album</i>	ch; s			25	14		3	4		2	1	1	3					6				
<i>Chenopodium album</i>	uch; s	13	8										4	2	2	1	1				2	
<i>Fallopia convolvulus</i>	ch; n			1					1													
<i>Fallopia convolvulus</i>	uch; n		1			1							2				1					
cf. <i>Melandrium album</i>	ch; s	1																				
<i>Polygonum aviculare</i>	uch; n												1									
<i>Rumex acetosa</i>	ch; n											1	1		1	1			3	1		
<i>Stellaria graminea</i>	uch; s	2																				
<i>Bromus</i> sp.	ch; f, g																				2	1
Poacea indet.	ch; f, g				1																	5
Polygonaceae	ch; f, n											1										
<i>Betula pendula</i>	uch; sh														1	3						
Indeterminate	ch, f, un					1											1					
Indeterminate	uch, f, un									1			1	5								1

generally classified as grasses (Poaceae indet.), as well as fragments of knotweed fruits (Polygonaceae indet.).

Targowisko 16 site

As a result of microscopic observations 1,756 diaspores were obtained from 110 samples. In the case of four samples, no plant remains were found.

Based on the analysis, a list of 19 taxa was developed. Among them, 12 plant species were identified. Four taxa are labeled to the genus level. Two taxa were defined only to the rank of family (Tab. 3). Registered plant remains were preserved in the form of uncharred and charred specimens.

In the analysed material, the share of charred remains was only 1%, as only 18 diaspores preserved in this state were registered. The vast majority (1,738 specimens) were unburned remains, mainly the remains of plants that were both segetal and ruderal weeds. There have also been individual tree-owned diaspores.

Charred macroscopic remains were recorded in only 12 samples, coming from eight objects: 26 (sample no. 31), 42 (sample no. 59), 44 (samples no. 71, 74), 44B (samples no. 76, 78), 45 (samples no. 80, 85, 87), 45A (sample no. 90), 50 (sample no. 97) and from object 53 (sample no. 100) (Tab. 4).

Among the 18 charred plant remains, the remains of wild-growing arable and herbaceous plants were found. The share of arable crops was 5%. with herbaceous plants accounting for 39%. The percentage of indeterminate specimens was 56%.

Crops

In the research material from Targowisko 16, only one emmer wheat (*Triticum dicoccum*) was found among the charred remains. The presence of grain kernel was recorded in sample No. 76 from object 44B.

No other remains that could be determined as cereals were found in the analysed material.

Wild herbaceous plants

A slightly larger group of remains were those belonging to herbaceous wild plants, occupying two types of habitats. In total, the materials determined seven specimens, with species belonging to the weeds of agricultural fields (segetal) and ruderal habitats identified. Single specimens were recorded in the research material: fat-hen (*Chenopodium album*), redshank (*Polygonum persicaria*) and common sorrel (*Rumex acetosa*).

A charred seed belonging to fat-hen (*Ch. Album*) was recorded in only one sample no. 97, from object no. 50. A charred nutlet of redshank (*P. persicaria*) oc-

Table 3. Targowisko, site 16. Kłaj commune, Małopolskie voivodeship. List of taxa recognized in the research material (all samples).

Key: uch – uncharred; ch – charred

Taxa name	State of preservation	Number of specimens	Number of samples
<i>Triticum dicoccum</i>	ch	1	1
<i>Chenopodium album</i>	ch	1	1
<i>Chenopodium album</i>	uch	534	79
<i>Echinochloa crus-galli</i>	uch	4	4
<i>Fallopia convolvulus</i>	uch	99	27
<i>Polygonum aviculare</i>	uch	237	41
<i>Polygonum lapathifolium</i>	uch	25	11
<i>Polygonum persicaria</i>	ch	1	1
<i>Polygonum persicaria</i>	uch	73	18
<i>Raphanus raphanistrum</i>	uch	3	1
<i>Rumex acetosa</i>	ch	5	4
<i>Rumex acetosa</i>	uch	2	1
<i>Scleranthus annuus</i>	uch	221	34
<i>Setaria pumila</i>	uch	101	21
<i>Atriplex</i> sp.	uch	1	1
<i>Chenopodium</i> sp.	uch	216	28
<i>Setaria</i> sp.	uch	20	10
<i>Stellaria</i> sp.	uch	1	1
<i>Viola</i> sp.	uch	3	3
Poacea indet.	uch	23	10
Polygonaceae	uch	5	2
<i>Betula pendula</i>	uch	1	1
<i>Betula</i> sp.	uch	7	5
Indeterminata	ch	10	7
Indeterminata	uch	162	53
Total number 1756			-

Table 4. Targowisko, site 16, Kłaj commune, Małopolskie voivodeship. List of selected samples containing charred macroscopic plant remains.

Key: uch – uncharred; ch – charred; g – grain; f – fragments; n – nutlets; sh – seed hulls; s – seed; c – calyx; un – undefined

Taxa name	State of preservation and kind of remains	Sample number											
		31	59	71	74	76	78	80	85	87	90	97	100
<i>Triticum dicoccum</i>	ch, g					1							
<i>Chenopodium album</i>	ch, s											1	
<i>Chenopodium album</i>	uch, s			1			1	3	1		1		3
<i>Echinochloa crus-galli</i>	uch, g									1			
<i>Polygonum aviculare</i>	uch, f, n							1					
<i>Polygonum lapathifolium</i>	uch, n							6	1				
<i>Polygonum persicaria</i>	ch, n										1		
<i>Raphanus raphanistrum</i>	uch, s							4					
<i>Rumex acetosa</i>	ch, n				1	1		2		1			
<i>Scleranthus annuus</i>	uch, c								1				
<i>Setaria pumila</i>	uch, g	6				1	1	3					
<i>Chenopodium</i> sp.	uch, f, s							5					
<i>Betula pendula</i>	uch, sh									1			
<i>Betula</i> sp.	n												2
Indeterminata	ch, f, un	1	1	1			3		1	2			1
Indeterminata	uch, g							2					

curred in sample no. 90 from object no. 45A. In turn, single common sorrel (*R. acetosa*) was recorded in four samples. The samples containing the remains of common sorrel came from three objects: 44 (sample no. 74), 44B (sample no. 76) and 45 (sample no. 80 and 87).

In addition, 10 charred fragments of plant remains, probably some seeds, were obtained from seven samples, which due to the state of preservation, were not determined (Indeterminata).

Targowisko 14–15 site

As mentioned above, 74 samples were analysed from this archaeological site. As a result of microscopic observations, a total of 1,380 diaspores were obtained from 69 samples. No plant remains was found in 5 samples. A list of 25 taxa was constructed (Tab. 5).

Among them, 17 species of plants were identified. Four taxa are determined to the genus level, four taxa were assigned to the rank of family and the registered plant remains were preserved in the form of uncharred and charred specimens. In the case of materials from Targowisko 14–15, similar to the previously discussed archaeological sites, uncharred specimens have been treated as younger material than the objects from which the samples were taken.

In the analysed material, only 87 charred plant remains were noticed, which is only 6% of recorded diaspores. The vast majority (1,293 specimens) belonged to the modern remains of plants that were both segetal and ruderal weeds.

Charred plant remains were recorded in 22 samples from objects: 1 (samples no. 41, 42, 44, 48–50,

Table 5. Targowisko, site 14–15. Kłaj commune, Małopolskie voivodeship. List of taxa recognized in the research material (all samples).

Key: uch – uncharred; ch – charred; m – mieneralized

Taxa name	State of preservation	Number of specimens	Number of samples
<i>Triticum dicoccum</i>	ch	16	5
<i>Triticum monococcum</i>	ch	2	2
<i>Triticum cf. monococcum</i>	ch	1	1
<i>Triticum sp.</i>	ch	6	2
<i>Cerealia indet.</i>	ch	16	7
<i>Chenopodium album</i>	uch	174	24
<i>Echinochloa crus-galli</i>	uch	1	1
<i>Fallopia convolvulus</i>	uch, m	22 + 3m	9+2
<i>Galeopsis tetrahit</i>	uch	3	3
<i>Polygonum aviculare</i>	uch	3	2
<i>Polygonum hydropiper</i>	uch	1	1
<i>Polygonum lapathifolium</i>	uch	56	12
<i>Polygonum persicaria</i>	uch	313	30
<i>Raphanus raphanistrum</i>	uch	10	3
<i>Rumex acetosella</i>	ch	1	1
<i>Rumex acetosa</i>	ch	4	4
<i>Rumex acetosa</i>	uch	12	2
<i>Scleranthus annuus</i>	uch	142	10
<i>Setaria pumila</i>	uch	416	30
<i>Stachys annua</i>	uch	1	1
<i>Bromus sp.</i>	ch	1	1
<i>Chenopodium sp.</i>	uch	17	2
Lamiaceae	uch	5	4
Poacea indet.	ch	6	3
Poacea indet.		50	11
Polygonaceae	uch	5	3
<i>Betula pendula</i> (nch)	uch	1	1
<i>Betula sp.</i> (nch)	uch	2	2
Indeterminata	ch	39	15
Indeterminata	uch	51	13
Total number			1380
			-

60–66, 68 and 69), 1B (sample no. 67), 1C (samples no. 45, 46), 1D (samples no. 51, 55, 57) and from object 3 (sample no. 1) (Tab. 6), and belonged to arable crops (41%) and herbaceous plants (14%). The rest charred remains were indeterminate specimens and accounted for 45%.

Crops

The remains of the cereals were preserved in the form of grains. Among the 36 remains included in this group most of the grains belonged to wheats, and of these the presence of emmer (*T. dicoccum*) was the most numerous. Apart from the emmer, einkorn wheat (*T. monococcum*) and probably einkorn wheat (*Triticum cf. monococcum*) were found. In the group of cereals, a single wheat kernel (*Triticum sp.*) and several fragments of cereal kernels were also found, which due to their state of preservation remained undetermined (*Cerealia indet.*) (Tab. 6).

Emmer wheat (*T. dicoccum*) in form of 16 grains, was found in five samples. Three of them were taken from object 1 (sample no. 42, 44 and 66) and contained in total 14 grains. Rest of remains of emmer wheat came from object 1C (sample no. 46) and 1D (sample no. 55).

The single grains of einkorn wheat (*T. monococcum*) recorded in two samples, one from object 1 (sample no. 50) and the other from object 1C (sample no. 46). On the other hand, the kernel, probably belonging to einkorn wheat (*T. cf. monococcum*), came from object 1D, from sample no. 57.

In addition to this, the charred material contained fragments of wheat grains (*Triticum sp.*) which were found in sample no. 46, from object 1C.

The remainder of the 16 remains were determined as undefined cereals (*Cerealia indet.*) and recorded in seven samples, mainly from object no. 1 (samples no.

Table 6. Targowisko, site 14–15, Kłaj commune, Małopolskie voivodeship. List of selected samples containing charred macroscopic plant remains.

Key: uch – uncharred; ch – charred; g – grain; f – fragments; n – nutlets; sh – seed hulls; s – seed; un – undefined

Taxa name	State of preservation and kind of remains	Sample number																						
		1	41	42	44	45	46	48	49	50	51	55	57	60	61	62	63	64	65	66	67	68	69	
<i>Triticum dicoccum</i>	ch, g			5	2		5					2									2			
<i>Triticum monococcum</i>	ch, g						1			1														
<i>Triticum cf. monococcum</i>	ch, f, g											1												
<i>Triticum sp.</i>	ch, f, g						5																	
<i>Cerealia indet.</i>	ch, f, g			4	4							2	1		1		1	3						
<i>Chenopodium album</i>	uch, s	17																						
<i>Fallopia convolvulus</i>	uch, n	3																						
<i>Polygonum lapathifolium</i>	uch, n	10																						
<i>Polygonum persicaria</i>	uch, n	38																						
<i>Raphanus raphanistrum</i>	uch, s																			3				
<i>Rumex acetosella</i>	ch, n																			1				
<i>Rumex acetosa</i>	ch, n		1		1			1										1						
<i>Setaria pumila</i>	uch, g	7																						
<i>Bromus sp.</i>	ch, f, g							1																
Poaceae indet.	ch, f, g				1			3							2									
Poaceae indet.	uch, g	4																						
Polygonaceae	uch, f, n											1	2											
<i>Betula pendula</i>	uch, sh																1							
<i>Betula sp.</i>	uch, sh					1																	1	
Indeterminata	ch, un	3		4	3	1		4	1	2	2			1		3				3	4	2	3	3
Indeterminata	uch, un												1				1							

42, 44, 61, 63 and 64) – a total of 13 grain fragments and from object 1D (samples no. 55 and 57).

Wild herbaceous plants

A small group of remains were those belonging to wild herbaceous plants, with species belonging to the weeds of arable fields (segetal) and ruderal habitats were identified. The weeds of arable fields have a life cycle closely related to the life cycle of cultivated plants (Tymrakiewicz 1962, 7). Ruderal plants are species that accompany human settlements, develop spontaneously on soils enriched with easily soluble mineral salts, such as nitrogen compounds, phosphates or mineral salts (Kornaś 1972). A total of 12 specimens were recorded, which accounted for 14% of the charred remains. In the research material, single specimens of brome grass (*Bromus* sp.), sheep sorrel (*Rumex acetosella*) and garden sorrel (*Rumex acetosa*) were recorded. In addition, kernel fragments were found which, due to their conservation status, were identified as belonging to the grasses family (Poaceae indet.).

The grain brome grass (*Bromus* sp.) was recorded in sample no. 48 from object 1. Nutlets of common sorrel (*R. acetosa*) and three fragments of grasses carypses (Poaceae indet.) were also found in this sample.

Common sorrel fruit (*R. acetosa*) were found in materials from object 1, in samples no. 41, 44, 48 and 64.

One specimen of sheep sorrel (*R. acetosella*) was obtained from object 1, from sample no. 65.

Summary

All of the samples from all three archaeological sites contained small numbers of charred remains, with some grains of crops and seeds of weeds surviving. One thing has to be mentioned, namely that no spikelet forks were found among all charred remains. Nevertheless, based on these modest results, we gained an important information about plants used in the past in this part of Poland.

The analysed material may not contain a large group of charred plant remains, but nevertheless they are a valuable source of information crops cultivated in the early Neolithic period.

In materials from LBK culture sites Brzezcie 40 and Targowisko 16, single remains of cereals such as wheat (*Triticum* sp.) and emmer wheat (*T. dicoccum*) were determined. From Brzezcie 40 we also have a grains of undetermined cereals (Cerealina indet.). This results look similar to this one from Targowisko 10–11 (Lityńska-Zajęc et al. 2014, 612). Based on results from

Targowisko 10–11, and other LBK culture sites (e.g. Lityńska-Zajęc et al. 2014; 2017; Mueller-Bieniek et al. 2018), it seems to be correct to presume that *T. dicoccum* was the main crop cultivated during LBK culture times.

In terms of the Targowisko 14–15 MC culture site, things look a little bit different. First of all, the number of crop remains was higher and more varied. Besides of undetermined cereals and *T. dicoccum* presence of *T. monococcum* was noticed. In this situation it looks also similar to results from Targowisko 10–11 (Lityńska-Zajęc et al. 2014, 613). The presence of emmer wheat kernels and a small share of einkorn wheat reflect the data obtained so far on Neolithic crops. (Klichowska 1961; 1975; Gluza 1983/1984; Jankowska 1997; Lityńska-Zajęc et al. 2017; Nowak et al. 2020). Single sheep sorrel specimens may indicate that such animals grazed here (cf. Nalepka 2005, 89; Pelisiak 2005, 34).

The presence of charred fat-hen and black-bindweed seeds could indicate the use of these plants, e.g. for consumption purposes (Henslowa 1962; Łuczaj 2008), but the modest number of specimens in the case of Targowisko 16 and Targowisko 14–15 does not warrant such a conclusion. A contrasting situation is in Brzezcie 40, where fat-hen's seeds were more numerous and came from one particular feature. In archaeobotanical materials related to the Neolithic, an accumulation of remains of these plants was noted, e.g. in Ludwinów, province Kujawsko-Pomorskie, which indicates that fat-hen could have been collected on purpose (Mueller-Bieniek et al. 2019).

It should be emphasized that the infiltration of plant material into archaeological objects is influenced, *inter alia*, by the cultivation of plants, the method of harvest processing, food preparation, storage of crops for various food and economic purposes or treating leftovers as waste (van der Veen 1992, 86; Lityńska-Zajęc 2005, 32). It should also be remembered that probably never all species of crops and weeds growing in ancient fields in prehistoric and early historic times have been fully represented in archaeobotanical samples. For this reason, the data from archaeological excavations do not reflect the full diversity of communities and habitats (Lityńska-Zajęc 2005, 34).

The materials from Brzezcie 40, Targowisko 16 and Targowisko 14–15 definitely require further analysis. It seems necessary to analyse the archaeological features from the functional aspect, together with the arrangement of plant remains inside archaeological features and compare them to other already known botanical material from this area.

Acknowledgements

The work was created as a result of the research project NCN No. 2016/21/B/HS3/03137 financed by the National Science Centre.

References

- Anioł-Kwiatkowska J. 2003. *Wielojęzyczny słownik florystyczny*. Wrocław: Wydawnictwo Uniwersytetu Wrocławskiego.
- Cappers R. T. and Bekker R. M. 2013. *A Manual for the Identification of Plant Seeds and Fruits (= Groningen Archaeological Studies 23)*. Groningen: Barkhuis Publishing & Groningen University Library.
- Cappers R. T. J., Bekker R. M. and Jans J. E. A. 2006. *Digital Seeds Atlas of the Netherlands (= Groningen Archaeological Studies 4)*. Groningen: Barkhuis.
- Gluza I. 1983/1984. Neolithic cereals and weeds from locality of the Lengyel Culture at Nowa Huta–Mogiła near Cracow. *Acta Palaeobotanica* 23, 123–184.
- Golański A., Kadrow S. and Krzywda A. 2021. Field Research in the Targowisko Region in 2018–2019. *Analecta Archaeologica Ressoviensia* 16, 19–41.
- Golański A., Kadrow S. and Posselt M. 2019. Prospekcja geomagnetyczna wczesnoneolitycznego kompleksu osadniczego w Targowisku, woj. małopolskie. *Raport* 14, 7–20.
- Górski J. and Konieczny B. 2014. Badania wykopaliskowe w Targowisku, pow. wielicki. Zagadnienia wstępne. In J. Górski (ed.), *Kompleks osadniczy kultury łużyckiej w Targowisku, stan. 10–12, pow. wielicki (= Via Archaeologica. Źródła z badań wykopaliskowych na trasie autostrady A-4 w Małopolsce)*. Kraków: Krakowski Zespół do Badań Autostrad, 7–13.
- Henslowa M. 1962. *Rośliny dziko rosnące w kulturze ludu polskiego (Chenopodium, Atriplex, Urtica, Rumex, Sambucus) (= Archiwum Etnograficzne 25)*. Wrocław: Polskie Towarzystwo Ludoznawcze.
- Jacomet S. 2006. *Identification of cereal remains from archaeological sites*. Basel: Basel University.
- Jankowska D. 1997. Neolityczne spichrze z obszaru ziem polskich. *Sborník prací Filozofické fakulty Brněnské univerzity. Řada archeologická (M)* 46/2, 113–124.
- Kadrow S., Posselt M., Saile T., Wąs M., Abramów J. and Golański A. 2021. Culture transformation in Targowisko microregion. Trends of changes inside Danubian farmers. *Sprawozdania Archeologiczne* 73(1), 153–176.
- Katz N. Ja., Katz S. V. and Kipiani M. G. 1965. *Atlas and keys of fruits and seeds occurring in the quaternary deposits of the USSR*. Moskwa: Nauka.
- Klichowska M. 1961. Znaleziska zbóż na terenie ziem polskich od neolitu do XII wieku n.e. *Kwartalnik Historii Kultury Materialnej* 9(4), 675–701.
- Klichowska M. 1975. Najstarsze zboża z wykopalisk polskich. *Archeologia Polski* 20(1), 83–140.
- Kornaś J. 1972. Zespoły synantropijne. In W. Szafer and K. Zarzycki (eds.), *Szata roślinna Polski*, 1. Warszawa: Państwowe Wydawnictwo Naukowe, 442–464.
- Kowal T. 1953. Klucz do oznaczania nasion rodzajów *Chenopodium L.* i *Atriplex L.* *Monographiae Botanicae* 1, 87–163.
- Kulpa W. 1988. *Nasionoznawstwo chwastów*. Warszawa: Państwowe Wydawnictwo Rolnicze i Leśne.
- Lityńska-Zajac M. 2005. *Chwasty w uprawach roślinnych w pradziejach i wczesnym średniowieczu*. Kraków: Instytut Archeologii i Etnologii Polskiej Akademii Nauk.
- Lityńska-Zajac M., Czekaj-Zastawny A. and Rauba-Bukowska A. 2017. Utilisation of cultivated and wild plants in the economy of the Linear Pottery Culture in the Upper Vistula basin. *Sprawozdania Archeologiczne* 69, 271–295.
- Lityńska-Zajac M., Tomczyńska Z., Wasylkowa K., Cywa K. and Madeyska E. 2014. Pozostałości roślinne z obiektów neolitycznych na stanowisku 10, 11 w Targowisku, pow. wielicki. In A. Zastawny (ed.), *Targowisko stan. 10, 11. Osadnictwo z epoki kamienia (= Via Archaeologica. Źródła z badań wykopaliskowych na trasie autostrady A-4 w Małopolsce 8)*. Kraków: Kraków: Krakowski Zespół do Badań Autostrad, 611–629.
- Lityńska-Zajac M. and Wasylkowa K. 2005. *Przewodnik do badań archeobotanicznych*. Poznań: Sorus.
- Łuczaj Ł. 2008. Dzikie rośliny jadalne używane w okresie niedoboru żywności we wschodniej części Karpat (powiat Krosno, Sanok, Lesko, Nadwórna, Kosów i Kołomyja) według ankiety szkolnej z 1934 r. In Ł. Łuczaj (ed.), *Dzikie rośliny jadalne. Zapomniany potencjał przyrodniczy*. Bolestraszyce: Arboretum i Zakład Fizjografii w Bolestraszycach, 161–181.
- Marek S. 1954. Cechy morfologiczne i anatomiczne owoców rodzajów *Polygonum L.* i *Rumex L.* oraz klucze do ich oznaczania. *Monographiae Botanicae* 2, 77–193.
- Mądalski J. 1957. *Atlas flory polskiej i ziem ościennych*, 7(1): *Chenopodiaceae*. Warszawa, Wrocław: Państwowe Wydawnictwo Naukowe.
- Mądalski J. 1965. *Atlas flory polskiej i ziem ościennych*, 6(5): *Polygonaceae*. Warszawa, Wrocław: Państwowe Wydawnictwo Naukowe.
- Mądalski J. 1967. *Atlas flory polskiej i ziem ościennych*, 6(5a): *Polygonaceae, Platanaceae*. Warszawa, Wrocław: Państwowe Wydawnictwo Naukowe.

- Mirek Z., Piękoś-Mirkowa H., Zając A. and Zając M. 2002. *Flowering plants and pteridophytes of Poland. A checklist*. Kraków: W. Szafer Institute of Botany, Polish Academy of Sciences.
- Mueller-Bieniek A., Moskal-del Hoyo M. and Kapcia M. 2019. Próba odtworzenia gospodarki roślinnej na podstawie badań archeobotanicznych. In J. Pyzel (ed.), *Ludwinowo, stan. 7. Osada neolityczna na Kujawach* (= *Ocalone Dziedzictwo Archeologiczne* 8). Pękowo, Gdańsk: Profil-Archeo, Wydawnictwo Uniwersytetu Gdańskiego, 317–361.
- Mueller-Bieniek A., Moskal-del Hoyo M., Kapcia M. and Przybyła M. 2018. Traces of supposed neolithic plant husbandry in the multicultural site 3 at Miechów, southern Poland. In P. Valde-Nowak, K. Sobczyk, M. Nowak and J. Żrałka (eds.), *Multas per gentes et multa per saecula: amici magistro et collegae suo Ioanni Christopho Kozłowski dedicant*. Kraków: Institute of Archaeology Jagiellonian University, Alter Publishing House, 601–608.
- Nalepka D. 2005. Palinologiczne ślady gospodarki człowieka w dwóch profilach z małego torfowiska w Osłonkach na Kujawach. *Botanical Guidebook* 28, 87–91.
- Neef R., Cappers R. T. J. and Bekker R. M. 2012. Digital Atlas of Economic Plant in Archaeology (= *Groningen Archaeological Studies* 17). Groningen: Barkhuis.
- Nowak M., Lityńska-Zając M., Moskal-del Hoyo M., Mueller-Bieniek A., Kapcia M. and Kotynia K. 2020. Plants of the Funnel Beaker culture in Poland. *Sprawozdania Archeologiczne* 72(1), 87–113.
- Pelisiak A. 2005. Osadnictwo i gospodarka w neolicie we wschodniej części Karpat polskich. Konfrontacja informacji archeologicznych i palinologicznych. *Botanical Guidebook* 28, 29–52.
- Skrzypczak G., Blecharczyk A. and Swędryński A. 2000. *Podręczny atlas chwastów*. Poznań: Medix Plus.
- Tymrakiewicz W. 1962. *Atlas chwastów*. Warszawa: Państwowe Wydawnictwo Rolnicze i Leśne.
- van der Veen M. 1992. *Crop Husbandry Regimes. An Archaeobotanical Study of Farming in northern England 1000 BC – AD 500* (= *Sheffield Archaeological Monographs* 3). Sheffield: J. R. Collins Publications, Department of Archaeology and Prehistory University of Sheffield.