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NEW ISOTOPIC DATA ON THE DIET OF THE SAKA PERIOD POPULATION FROM CENTRAL KAZAKHSTAN

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This paper presents the results of stable isotope analysis of the Saka period population of Central Kazakhstan. The analysed materials originate from 37 sites of the Tasmola Culture which is presently dated to the 8th – 5th c. BC. The sample include 31 humans from 31 burials and 6 animals from three settlements and three burials. Human isotopic results are widely scattered both in $\delta^{13}C$, and in $\delta^{15}N$ ratios from the cemeteries of Koitas, Taldy-2, Akbeit and Karashoky. The obtained data suggests the presence of millet in Central Kazakhstan in the beginning of the Early Iron Age, either as agricultural crop or imported product. The findings of a small quantity of millet and barley grains in the cultural layer of one of the Tasmola Culture settlements supports this hypothesis. These findings represent the first phase of the research. A more representative series of samples, including faunal, is needed for a more comprehensive investigation of the topic.

Keywords: archaeology, stable isotope analysis, palaeodiet, Tasmola culture, Central Kazakhstan, burial, settlement, methodology, ultrafiltration method.

Introduction.

In this paper, we present the results of stable isotope analysis of the Tasmola Culture population of Central Kazakhstan. Since materials were received by M.K. Kadyrbayev in 1950–1970 (Kadyrbaev, 1966), the source base for the Tasmola problem has grown significantly by today. According to the latest research, this culture dates to the 8th–5th c. BC (Beisenov, 2015; Beisenov et al., 2016). In addition to the new cemeteries, new types of sites have been discovered. At the moment, materials from settlements, which were completely absent in the earlier studies, are of particular importance.

Central Kazakhstan is a part of the Kazakh Uplands with a characteristic landscape of hilly steppes, rocky ranges and island low-hill terrains. Landscape areas are extremely diverse, and even include deserts. The climate is sharply continental, with hot summers and cold winters. The specific characteristics of the climate are determined by rather strong winds, which in winters create snow storms common in the past. Here, the economy remained predominantly pastoral not only for the Saka epoch, but also for the subsequent periods (Beisenov, Shulga, Loman, 2017).

Palaeoclimatic studies indicate that in the end of the Bronze Age the steppe zone of Kazakhstan was much drier than at present. This period was characterized by arid conditions, with dominating dry steppe and desert landscapes (Zdanovich and Schreiber, 1990; Tairov, 2003). Aridisation of the climate in the final Bronze Age, which ultimately resulted in ecological crisis, reduction of the role of agriculture and the emergence of mobile forms of pastoralism, has been also recorded for the ancient cultures of Ukraine (Makhortyh, 2005). It has been suggested that ca. 900–800 BC there was an increase in humidity and reduction of continentality of climate in the steppe zone of Eurasia, which escalated productivity of pastures compared to the Late Bronze Age period.

The palaeoclimatic data correlates with archaeological materials from Kazakhstan and other Eurasian Steppe regions. What is the comparative topography of the Bronze Age versus Early Iron Age settlements? The answer can be found, in particular, among materials from Central Kazakhstan. In this region, Bronze Age settlements are located along the steppe rivers and large streams, at a short distance from river beds. In contrast, settlements of the Saka period are located further from rivers on hill slopes. Many features of these monuments support the above assumptions about increased humidity in the region at the beginning of the 1st mil. BC. Slope topography, clustered planigraphy, thick-walled squat relatively small stone buildings (Beisenov, Shulga, Loman, 2017, fig. 12, 13) argue for colder conditions and prevalence of snowy and windy winters. Saka period settlements in Central Kazakhstan, apparently, were winter dwellings. These settlements emerged during the adaptation of the population to the new climate regime which suggests their environmental conditionality (Beisenov 2014; 2017). In the recent past, such settlements were called winter camps: "qystaq" or "qystau" in the Kazakh language, or, in Uzbek, by the similar term «qishlaq».

As such, if we take into consideration specifics of the Saka settlements and houses in Central Kazakhstan, we could assume that the suggested increase in humidity during 900–800 BC was associated with colder conditions. To date, more than 50 small settlements of the Saka period have been discovered in the eastern mountain areas of Central Kazakhstan (Beisenov, Shulga, Loman, 2017, fig. 1), eleven of which have been excavated. It is data from these sites which allows making certain conclusions about significant climate change in Central Kazakhstan in the Early Iron Age. Meanwhile, important results have been achieved when comparing the Saka materials with similar or closely related data for Kazakh people living in the locations of Saka settlements in the 19th and early 20th c.

Regarding the stock breeding practices of the ancient population of Central Kazakhstan, M.K. Kadyrbaev noted that people of the Tasmola Culture were primarily herders and horsed warriors (Kadyrbaev, 1966, p. 415). Based on the materials from their excavations, they described the types of Tasmola horses and sheep. The horses were of two breeds: one cobby, thick-legged with a massive head and wide body, and another more stalwart, used by mounted warriors. Tasmola sheep were massive, close to the Kazakh steatopygous type. Yet, these sheep show significant similarities with wild forms, in particular, with argali (Kadyrbaev, 1966, p. 414–415).

Anthropological data for the Tasmola Culture suggests that the diet of the population was based on protein with low proportion of carbohydrates (Beisenov, Ismagulova, Kitov, Kitova, 2015, p. 1411). Generally, according to modern perception, a purely pastoral lifestyle was very rare in steppe populations, and agriculture was always present to various extent (Beisenov, Shulga, Loman, 2017).

Use of Stable Isotope Analysis

Stable isotope analysis has been successfully applied in scientific research since the late 1970s. Since then, it became one of the most informative methods for understanding the diet of ancient societies, their life support systems, resources and adaptations. Analysis of stable carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) isotopes is widely used in modern palaeodietary

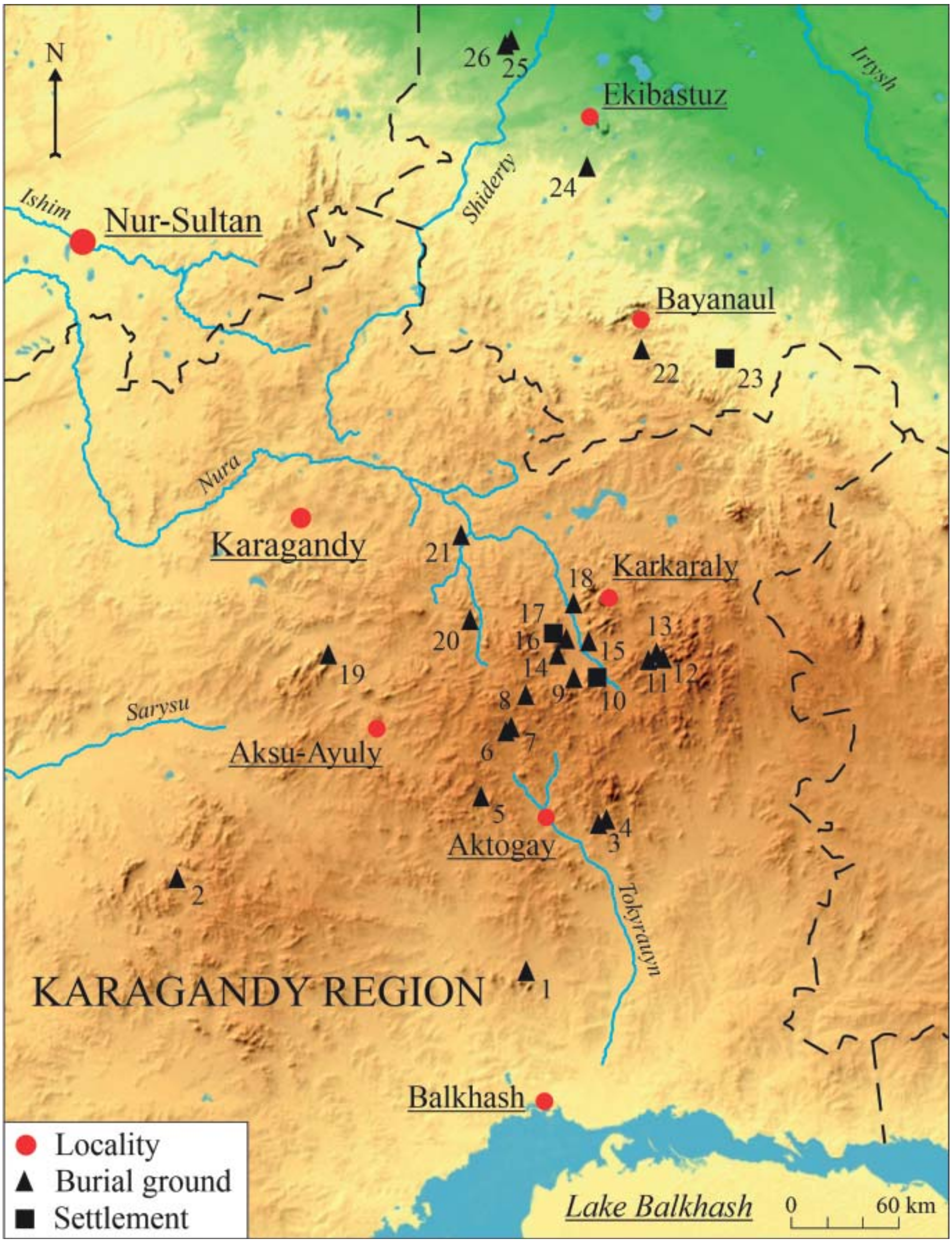

Fig. 1. Location map of the analyzed sites. 1 – Bektauata; 2 – Koishoky-5; 3 – Begazy; 4 – Kyzyl; 5 – "37 warriors"; 6 – Karashoky; 7 – Karashoky-6; 8 – Akbeit; 9 – Bakibulak; 10 – Sarybuirat; 11 – Koitas; 12 – Taisoigan; 13 – Taldy-2; 14 – Nurken-2; 15 – Nazar-2; 16 – Kabakshi; 17 – Abylai; 18 – Kosoba; 19 – Kizilkoi; 20 – Zhamantas; 21 – Tandaily-2; 22 – Kyzykshilik; 23 – Tagibaibulak; 24 – Birlik; 25 – Tortyi, 8; 26 – Tortyi-3.

Рис. 1. Карта расположения проанализированных памятников. 1 – Бектауата; 2 – Койшокы-5; 3 – Бегазы; 4 – Кызыл; 5 – "37 воинов"; 6 – Карашокы; 7 – Карашокы-6; 8 – Акбеит; 9 – Бакыбулак; 10 – Сарыбуйрат; 11 – Койтас; 12 – Тайсойган; 13 – Талды-2; 14 – Нуркен-2; 15 – Назар 2; 16 – Кабакши; 17 – Абылай; 18 – Кособа; 19 – Кызылкой; 20 – Жамантас; 21 – Тандайлы-2; 22 – Кызылшилик; 23 – Тагыбайбулак; 24 – Бирлик; 25 – Тортуй,8; 26 – Тортуй-3.

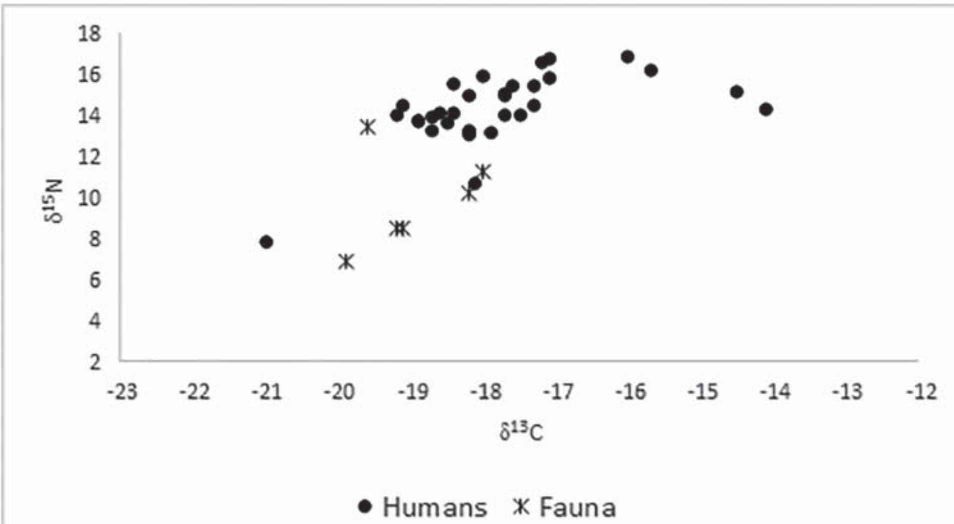

Fig. 2. The results of isotope analysis of human and animal Tasmola culture of Central Kazakhstan.

Рис. 2. Результаты изотопного анализа людей и животных тасмолинской культуры Центрального Казахстана.

research, and the technique has been well detailed in literature (see: (Reitsema, 2013; Svyatko, 2016)).

For the inland populations, $\delta^{13}C$ is used to evaluate the proportions of the so-called C_3 (most plants of temperate environments) versus C_4 plants (more common in the arid and hot climate and include such important agricultural crops as millet and maize) in the diet. C_3 plants are characterized by $\delta^{13}C$ values averaging about -26.5‰, while C_4 demonstrate $\delta^{13}C$ values averaging about -12.5‰ (Chisholm 1989; Larsen 1997). The bone collagen from herbivores that subsist only on C_3 grasses will give a $\delta^{13}C$ value of ca. -21.5‰. If the diet were based only on C_4 grasses then the value would be ca. -7.5‰. Ideally the proportions of C_3 and C_4 plants in a particular consumer's diet could be estimated. As a result of fractionation, $\delta^{13}C$ values of people will increase by approximately 1.5-2‰ in relation to those of consumed animals. The $\delta^{13}C$ in animals and humans are also dependent on several non-dietary factors such as the canopy effect (increase of leaf $\delta^{13}C$ from ground to canopy which might affect the entire foodchain; van der Merwe and Medina 1991) and climatic factors (higher plant $\delta^{13}C$ values as well as generally higher proportion of C_4 grasses with increase in temperature and decrease in the relative humidity (van Klinken et al., 1994).

Nitrogen isotope analysis is used to identify the trophic level of an individual with a 3–6‰ increase in each step of a food chain. The $\delta^{15}N$ values of most modern plants vary between 0 and 5‰ (e.g. DeNiro and Hastorf, 1985; Ambrose et al, 1997). Thus, the nitrogen isotopic values of populations that rely on terrestrial animal protein in their diet, would average from around 9‰, although this depends on the starting nitrogen isotopic values of local plants. The nitrogen isotopic levels of a consumer increase when relying more heavily on aquatic resources because of the extended food chains in aquatic ecosystems. The most relevant non-dietary factors include a climatic effect (increase of plant $\delta^{15}N$ ratios in arid environments; Schwarcz et al, 1999; Chase et al, 2012) and the manuring effect (increase of the $\delta^{15}N$ ratios of manured soil and associated plants; Bogaard et al, 2007; Bogaard et al, 2013).

It needs to be mentioned that, firstly, the results of the analysis of bone collagen principally reflect the consumption of protein-containing foods, while the sources of dietary carbohydrate or fat are invisible (Ambrose and Norr 1993; Ambrose 1993). Furthermore, sampled collagen reflects the diet of the last 5–15 years before death, depending on the bone measured and on the nutritional status of the individual.

Quite a few isotopic palaeodietary studies have been undertaken in Kazakhstan (O'Connell et al, 2003; Ventresca Miller et al, 2014; Lightfoot et al, 2015; Svyatko et al, 2015; Motuzaite Motuzeviciute et al, 2015, 2016), and the main conclusions from this research suggest that:

– until the Middle Bronze Age, the diet of the population was based on exclusively C_3 resources and did not include C_4 plants. Millet consumption was only detected in ca. 18 c. cal BC in South Kazakhstan and in the Final Bronze Age in Central Kazakhstan;

– fish was an important dietary source for many populations;

– the food choices were diverse, with some people eating various proportions of C_4 and C_3 plants.

For this analysis, we used 31 human samples from 31 burials and six animal samples from three settlements and three burials of the Tasmola Culture in Central Kazakhstan (Fig. 1). The samples radiocarbon date to the 8th–5th c. cal BC (Beisenov et al, 2016), as does the culture in general, with the exception of two animal bones from Koishoky-5, kurgan 1 which dated to 9th c. cal BC. According to the first data, this is the earliest monument of Tasmola culture. The search for new monuments in the area is relevant.

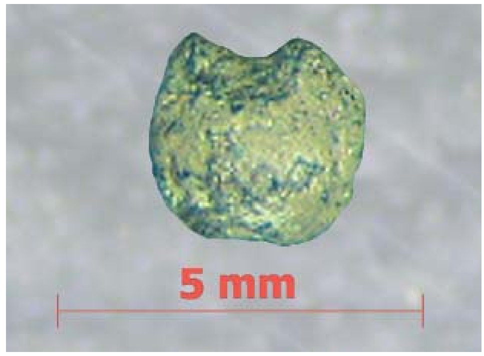

Fig. 3. Millet seed from the Saka time settlement of Abylai.
Photographed by A.S. Afonin.

Рис. 3. Зерновка проса из поселения сакского времени Абылай. Фото А.С. Афонина.

Results and Discussion

Stable isotope analysis was undertaken in the ^{14}CHRONO Centre for Climate, the Environment and Chronology (Queen's University Belfast, UK) using a standard ultrafiltration technique for collagen preparation Brown et al, 1988; Bronk Ramsey et al, 2004). The results are presented in Fig. 2 and Table 1. One of the analysed faunal samples (UBA-25472), identified as possibly ovicaprid, apparently belonged to a dog or human rather than an herbivorous species as its $\delta^{15}N$ value is close to human samples. Two other animal samples (UBA-39751 and UBA-39752) have relatively high $\delta^{15}N$ levels for herbivores (e.g. compared with animals pastured in temperate climates) which is possibly related to the climatic factor, such as

Fig. 4. Keli, Kazakh tool for grinding millet. From the collection of the Karaganda Historical Museum. Photographed by D.T. Shashenov.

Рис. 4. Кели, казахский инструмент для измельчения проса. Из фондов Карагандинского исторического музея. Фото Д.Т. Шашенова.

grazing on more arid steppe pastures. Faunal $\delta^{13}C$ values indicate that overall their diet consisted of C_3 grasses/feeds. Two human samples (UBA-39737 and UBA-25473) have possibly been misidentified for faunal species, as their $\delta^{15}N$ (and $\delta^{13}C$ in case of UBA-39737) are considerably lower than the rest of the group. Human isotopic values are widely scattered both in $\delta^{13}C$ and $\delta^{15}N$ (with the exception of samples UBA-39737 and UBA-25473, means are -17.8±2.3‰ and 14.3±3.6‰ respectively), and on average are 1.1‰ and 5.2‰ above similar indicators for animals (with the exception of sample UBA-25472, means for faunal samples are -18.9±0.8‰ and 9.1±1.7‰ respectively).

Wide scatter of carbon isotopic values in humans suggests that their diet included various quantities of C_4 plants, apparently millet. This is especially evident from the four human samples with the highest $\delta^{13}C$ rates from Koitas (kurgan 1), Taldy-2 (kurgan 2), Akbeit (kurgan 1) and Karashoky (kurgan 1). These individuals with the highest $\delta^{13}C$ levels date to the 8th–6th c. cal BC, suggesting the existence of millet in Central Kazakhstan in the beginning of the Early Iron Age, either as cultivated or imported crop. It is worth mentioning that these four individuals (Beisenov, 2014; Tur et al, 2016) come from the elite burial mounds – apparently millet was included into the diet of the high social strata of the Tasmola population. It is not clear from the available results whether any of the human diets included any fish.

As for the distribution of millet in Kazakhstan, it can be noted that isotopic data from previous studies demonstrated its consumption in the south-eastern regions of Kazakhstan from about the 18th c. BC (Motuzaite Matuzeviciute et al, 2015), and in Central Kazakhstan

Fig. 5. “Millet grinding on the Nura River”. Central Kazakhstan. Late XIX century. Photographed by S. Dudin. From (Rezvan 2016).

Рис. 5. «Толчение проса на реке Нура». Центральный Казахстан. Конец XIX в. Фото С. Дудина. (По Резван, 2016).

Table 1

Bone samples of humans and animals of the Tasmola culture, used for isotopic analysis

ID	$\delta^{13}C$	$\delta^{15}N$	$C:N_{at}$	% coll.	Sex	Age	Provenance
Human samples							
UBA-28344	-19.1	14.5	3.1	19.4	-	4-5	Bakybulak, k. 14
UBA-23671	-17.6	15.4	3.3	4.2	♀	25-35	Karashoky, k. 8
UBA-25474	-18.9	13.7	3.1	32.1	♀	35-45	Kyzyl, k. 3, left skeleton
UBA-28346	-18.0	15.9	3.3	11.2	♀	45-55	Kyzylkoy, k. 1
UBA-28349	-18.9	13.7	3.2	16.2	♀	18-25	Zhamantas kurgan
UBA-28350	-19.2	14.0	3.2	15.2	♀	18-25	Kyzylshilik, k. 8
UBA-28352	-18.6	14.1	3.2	14.0	♀	25-35	Birlik, k. 15
UBA-28353	-17.5	14.0	3.2	6.1	♀	35-45	Birlik, k. 29
UBA-23664	-14.1	14.3	3.2	16.4	-	-	Koitas, k. 1
UBA-23666	-17.1	15.8	3.2	9.0	-	-	Bakybulak, k. 15
UBA-23667	-14.5	15.2	3.3	11.7	-	-	Taldy-2, k. 2
UBA-23669	-18.4	14.1	3.2	10.3	-	-	Nazar-2, k. 2
UBA-23670	-17.7	15.0	3.3	6.9	-	-	Akbeit, k. 2
UBA-23673	-18.2	13.3	3.2	7.0	-	-	Taysoygan, k. 3
UBA-24917	-18.5	13.6	3.1	18.7	-	-	Kosoba, k. 2
UBA-28347	-18.7	13.3	3.2	15.0	-	-	Tandayly-2, k. 2
UBA-28351	-17.3	15.4	3.2	13.7	-	4-5	Akbeit, k. 7
UBA-28366	-18.2	15.0	3.2	4.1	-	-	Bakybulak, k. 2
UBA-23665	-18.7	13.9	3.2	8.8	♂	25-35	Nazar-2, k. 1
UBA-23668	-17.7	15.1	3.2	13.7	♂	25-35	Karashoky-6, k.1
UBA-23672	-15.7	16.2	3.3	7.9	♂	55+	Akbeit, k. 1
UBA-24916	-18.2	13.1	3.1	17.6	♂	25-35	Kyzylshilik, k. 2
UBA-24918	-18.4	15.5	3.1	17.5	♂	35-45	"37 warriors", k. 11
UBA-25473	-18.1	10.7	3.1	13.4	♂	25-35	Begazy, k.7
UBA-28343	-17.3	14.5	3.2	15.4	♂	35-45	Nurken-2, k. 1, lower skeleton
UBA-28345	-17.2	16.6	3.2	15.3	♂	35-45	Bektauata, k. 1
UBA-39737	-21.0	7.8	3.2	14.0	n/a	n/a	Kabakshi, k. 9
UBA-39747	-17.7	14.0	3.16	11.7	n/a	n/a	Tortui-3, k. 1
UBA-39748	-17.9	13.2	3.19	1.4	n/a	n/a	Tortui-8
UBA-39749	-17.1	16.8	3.15	2.8	n/a	n/a	Koishoky-5, k. 1
UBA-23674	-16.0	16.9	3.2	13.4	n/a	n/a	Karashoky, k. 1
Fauna samples							
UBA-23677	-19.1	8.5	3.2	3.6	ovicaprid		Tagybaybulak settlement, sq. A3, depth 25 cm
UBA-24915	-19.9	6.9	3.2	5.7	horse		Kyzylshilik, k. 2, edge of the mound, crepidoma
UBA-25472	-19.6	13.4	3.1	23.1	possibly ovicaprid		Sarybuirat settlement, sq. Б2, depth 30 cm.
UBA-39743	-19.2	8.5	3.19	3.5	n/a		Abylai settlement, sq. Б6, sacrifice pit 2
UBA-39751	-18.0	11.3	3.15	12.3	n/a		Koishoky-5, k. 1, near the standing stone
UBA-39752	-18.2	10.2	3.17	3.7	possibly ovicaprid		Koishoky-5, k. 1, under the “moustache” stones

from the end of the Bronze Age (Lightfoot et al, 2015).

All excavated settlements of the Saka period in Central Kazakhstan yielded significant numbers of stone hoes and graters. Trace analysis showed that graters were used for processing cereals (Beisenov, Shulga, Loman, 2017, p. 23–24). Our research in the settlement sites is still ongoing, and trace analysis of tools will also be expanded. This entirely new data has been obtained within the recent years. Carpological analysis of macro remains from the cultural layer of the Abylai settlement revealed few millet and barley grains (N.E. Ryabogina and A.S. Afonin, unpublished data; Fig. 3). For Central Kazakhstan, these are the first steps towards soil flotation in the Saka period settlements.

Being an undemanding crop for cultivation, millet was widely used by many steppe pastoralist populations. As few specialised studies have shown, in the eastern parts of Central Kazakhstan, crop cultivation existed within the stock-rearing economies, representing a unique adaptation system to the nomadic life. Irrigation was used for crop cultivation, and thus the harvest yields from such small areas were quite high for that period. For example, according to the data of the expedition by F. Scherbina undertaken in the end of the 19th c., in the Karkaraly Region where the large number of the studied Saka settlements are located, wheat harvest ratio averaged 10:1 and 15:1, and millet harvest ratio reached 150:1 and 160:1 (Beisenov, Shulga, Loman, 2017, p. 36-37).

Millet, called *tary* in Kazakh, was crushed by a simple wooden tool *keli* (Fig. 4, 5). In the past, this tool was common in all regions inhabited by the Kazakhs (Beisenov, Shulga, Loman, 2017).

Conclusion

Tasmola culture of Central Kazakhstan was discovered more than half a century ago. Over the past period, archeologists of Kazakhstan received a large amount of source data. Currently, the results of multidisciplinary research are particularly important.

The presented isotopic data for the Tasmola Culture allows making important conclusions on the use of millet in food in such an “indigenously pastoral” region as Central Kazakhstan, in the prehistory. Isotopic data needs to be incorporated as an integral part of the research into the Saka period culture of Central Kazakhstan, especially when concerning such an extremely understudied issue as economy. New analyses are essentially required, including those of faunal samples.

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ПЕРВЫЕ ИЗОТОПНЫЕ ДАННЫЕ О ДИЕТЕ НАСЕЛЕНИЯ САКСКОГО ВРЕМЕНИ ЦЕНТРАЛЬНОГО КАЗАХСТАНА

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В данной статье представлены результаты изотопного анализа населения сакского времени Центрального Казахстана. Проанализированные материалы происходят из 37 памятников тасмолинской культуры, которая в настоящее время датируется VIII–V вв. до н. э. Выборка включает 31 образец костей человека из 31 погребения и 6 образцов костей животных из трех поселений и трех погребений. Как показали результаты, изотопные показатели людей с погребений Койтас, Талды-2, Акбейт и Карашокы, отличаются большим разбросом, как в $\delta^{13}C$, так и $\delta^{15}N$. Полученные данные позволяют говорить о существовании проса в Центральном Казахстане в виде посевной культуры или импортируемого продукта, в начале эпохи железа. Находки немногочисленных зерен проса и ячменя в культурном слое одного поселения тасмолинской культуры не противоречат этой гипотезе. Такие находки представляют собой первый этап исследований. Для более полного исследования этой темы необходимы более представительные серии образцов, в том числе и по животным.

Ключевые слова: археология, изотопный анализ, диета древних обществ, Тасмолинская культура, Центральный Казахстан, погребение, поселение, методика, ультрафильтрационный метод.

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