

Traditionally used wild nitrogen-fixing plants in Bulgaria: the forgotten *Lathyrus tuberosus*

Mihail Chervenkov^{1,2} & Teodora Ivanova¹

¹ Institute of Biodiversity and Ecosystem Research, Department of Plant and Fungal Resources, Bulgarian Academy of Sciences, Acad. Georgi Bonchev St., bl. 23, 1113 Sofia, Bulgaria

² Faculty of Veterinary Medicine, University of Forestry, 10 Kliment Ohridski Blvd., 1756 Sofia, Bulgaria, e-mail: vdmchervenkov@abv.bg (author for correspondence)

Received: November 12, 2023 ▷ Accepted: November 26, 2023

Abstract. Tuberos nitrogen-fixing members of *Fabaceae* are currently studied as possible alternative crops that would permit cultivation on degraded soils and with reduced water use. The authors explore the historical and recent accounts of *Lathyrus tuberosus* L., its human consumption in Bulgaria using literature review and ethnobotanical field studies. Changes in land management and agricultural practices and depopulation of villages have thwarted traditional use related to the knowledge of behavior of blind mole-rats. So, opportunities of furthering its uses as animal forage, melliferous plant and green manure within the framework of ongoing climate changes and implementation of sustainable agricultural practices are discussed.

Key words: bioheritage, ecosystem services, edible tubers, *Lathyrus tuberosus*, *Nannospalax* sp., plant protein

Citation: Chervenkov, M. & Ivanova, T. 2023. Traditionally used wild nitrogen-fixing plants in Bulgaria: the forgotten *Lathyrus tuberosus*. – *Phytologia Balcanica*, 29(3): 377-384 – ISSN 1310-7771 (print), 1314-0027 (online).

Introduction

Land degradation (e.g., soil erosion, contamination, salinization, etc.) results in loss of biodiversity, including macro and microflora and fauna, and reduction of productivity (Ferreira & al. 2022; Haj-Amor & al. 2022). Continuous reliance on unsustainable agricultural practices has entailed depletion of both soil nutritives and (agro)biodiversity, which is limiting currently the adaptational potential of agro-systems on a global scale (Fontana & al. 2014; Zerbe

2022). Many of the earlier utilized crops and wild edible/forage plants, formerly reduced to rare or abandoned, are now rediscovered as alternative foods and bioactive substance sources and/or pools for useful genes that could be used in the breeding programs (Sthapit & al. 2017; Ramadhanti & al. 2019; Pei & al. 2020). Some of these taxa, being used both from the wild and as cultivated crops, should be considered part of the ecosystem services, both provisional and cultural, as their utilization is related to local ecological knowledge (Schulp & al. 2014).

Gradual urbanization of the European societies and highly industrialized agriculture have led to reduction of traditional knowledge. However, global efforts to reduce and possibly revert the Earth's ecosystems to more favourable conditions call for readoption of some traditional agricultural practices and reassessment of traditional knowledge (UN General Assembly 2019; European Commission 2020; Tataridas & al. 2022). This includes not only a cutback in pesticide usage and repudiation of monoculture cropping but also preservation of the natural landscapes and preference of low-input and multifunctional crops (Stagnari & al. 2017; Ulian & al. 2020).

Biological nitrogen fixation (BNF) is one of the sustainable ways to replenish and enhance soil fertility. Conversion of atmospheric nitrogen into usable forms, such as ammonia or nitrates, requires certain types of bacteria, fungi and other microorganisms, of which most fascinating are those occupying the plants root system that form plant-rhizobia associations. For that matter, BNF is essential for the growth and survival of many living organisms, as nitrogen is an important component of proteins, DNA, and other biological molecules. Out of nearly 600 plant taxa that are considered involved in N₂-fixation, members of the *Fabaceae* family are most frequently producing N-fixing root nodules (Tedersoo & al. 2018). While some neotropical legumes underperform due to changed pedoclimatic conditions in many regions, presently, some minor crops and wild relatives of the genera *Lablab*, *Lathyrus*, *Vicia*, *Vigna*, etc. have been screened as potentially more eco-friendly alternatives (McCulloch & al. 2021; Rathie & al. 2021).

Genus *Lathyrus* includes 160 species with diverse economic profiles, such as food, fodder, perfumery ingredients, and ornamental crops (Llorent-Martínez & al. 2017; Vaz Patto & Rubiales 2014). Specifically, the members of section *Lathyrus*, spread far and wide in the dry regions of the Mediterranean basin and western parts of the Irano-Turanian region, and have been used for millennia (Tosheva & al. 2004; Kenicer & al. 2005; Güneş & Çırpıcı 2015; Alexandrova & al. 2018; Hamzaoglu 2023). In the circum-Mediterranean region, *L. sativus* L. and *L. cicera* L. are among the most frequently reported findings in the archaeobotanical

sites, along with other legumes and cereals (Popova & Marinova 2007; Peña-Chocarro & Peña 1999; Mahler-Slasky & Kislev 2010; Valamoti & al. 2022).

Several *Lathyrus* species (excluding pea, *L. oleraceus* Lam., as commonly cultivated and used worldwide) are currently known for their use raw and/or boiled in the traditional cuisines of Europe and Asia Minor. In Spain, dry seeds of *L. sativus* are cooked like any usual legume, while in Turkey, tubers, seeds and green pods of *L. tuberosus* L. are consumed both raw or cooked in different dishes (Güneş & Özhatay 2008; Parada & al. 2011; Kadioglu & al. 2020). Traditionally the leaves and tendrils of *L. ochrus* (L.) DC. are served in salads and the seeds in soups in Cyprus (Polatoğlu & al. 2015). In Central Europe, the tubers of *L. tuberosus* are reported as children's and shepherd's snack consumed outdoors (Łuczaj 2012; Simkova & Polesny 2015; Stoličná 2016; Dénes 2017; Baránková 2022). Seeds of *L. aphaca* L. have been used in decoration of traditional confectionary (Dénes 2017). Ethnomedical evidence from Bosnia and Herzegovina has mentioned the application of tubers of *L. tuberosus* for treatment of digestive ailments and of diabetes in the Kars area in East Turkey (Šarić-Kundalić & al. 2010). Retaining the *Lathyrus* species as traditional food crops has been considered a relic of pre-Communist agriculture in some remote areas in the White Carpathian Mts. (Güneş & Özhatay 2008; Pawera & al. 2017). Unfortunately, the typical habitus of different fabaceous fodder plants (e.g., *Vicia*, *Lupinus*, *Lathyrus*, etc.) is quite undistinguishable for some authors in the humanities, who often regard different folk names as synonyms for one and the same species (Zirojević 2011).

Regardless of the global calls for diversification of the protein sources for human consumption, even the formerly most popular *L. sativus* and *L. cicera* are now seen as marginal, even for forage production (Hammer & al. 2019). While the introduction of some more efficient leguminous crops and of potatoes could be cited as the primary reason for neglecting these pre-Columbian pulses in Europe, mention deserves the fact that the seeds of *Lathyrus* spp. contain high levels of the anti-nutritional factor β-diamino-propionic acid (ODAP) that causes different forms of lathyrism (Tamburino & al. 2012; Barone & Tulumello 2020).

Ethnobotanical evidence on *Lathyrus* consumption

in Bulgaria is limited. *Lathyrus tuberosus* and *L. sylvestris* L. have been mentioned in folk songs, however, as pronouns to beloved persons, which signifies the positive connotation of those species, but without further ethnobotanical data (Ivanova & al. 2021b). Recently, seeds of *L. sativus* have been cited as used by Anatolian Bulgarians, who could have brought that tradition from Asia Minor during their translocation at the beginning of the 20th century. The Bulgarian National Genebank has currently holds accessions of four *Lathyrus* species, namely *L. sativus*, *L. clymenum*, *L. nissolia*, and *L. tinigitanus*, as well as few others to its working collections (Petrova & Chipilski 2020).

The current paper analyses the ethnobotanical data on historical and recent human consumption of *L. tuberosus* in Bulgaria reviewing the available literature and field inquiries in the Sliven province, Southeast Bulgaria. The authors have attempted to assess the challenges and opportunities for reintroduction of this multipurpose crop as part of the Green Economy pro-environmental measures.

Material and methods

Combined ethnographical, botanical and agricultural data were obtained both from print-only publications and review of major scientific databases (Web of Knowledge, Scopus, and ERIH PLUS). Field study area included the Sliven province (2015-2022) during a general ethnobotanical field study of traditionally consumed wild plants (Ivanova & al. 2021a, 2018). A total of 10 female and 11 male respondents, aged between 30 and 90 years (55 years on the average), who have participated in the gathering and/or consumption of the plant, were addressed by semi-structured interviews. The participants were requested to share their knowledge on collection and consumption of *L. tuberosus*, including ways for locating the tuber burials, frequency of burial hunting, sharing and cooking practices. The authors have focused on the experience of the locals who used to collect the tubers of *L. tuberosus* and on the knowledge they have acquired from earlier generations.

The ethical guidelines prescribed by the International Society of Ethnobiology have been followed (ISE Code of Ethics 2008).

Results

The alimental properties of *L. tuberosum* tubers are seldom mentioned in the Bulgarian floras and other early ethnobotanical references, both as animal feed and as human food, but their quoting lacks any reference to certain local traditions and/or dishes (Davidov & Yavashev 1939; Stojanov & Kitanov 1960; Stojanov & al. 1967). Until the late 1960s, the plant has been reported as “commonly known” wild edible plant with “chestnutty” taste (Mitev 1968). Interestingly, but even for agricultural experiments the same author used burials of blind mole-rats (family *Spalacidae*: *Nannospalax* sp.) to obtain tubers for further breeding. In the available ethnographical literature, human consumption has been reported fleetingly only for Omarchevo village, Nova Zagora Municipality (Detev 2014). The Bulgarian common names of the species have gravitated both towards general habitus and tuber-related descriptives: *Div Grah* (wild pea), *Fasuluche* (lesser bean), *Oreshki/Orehche/Oryashki* (from *oreh* – *Juglans regia* L.), *Gulien Grah* (from *gulya* – *Helianthus tuberosus* L.), *Grudesto Sekirche* (from *grudka* – tuber), *Glavest Urov* (from *glava* – head and *urov* – *Vicia ervilia* (L.) Willd.), and *Kuskoch* – similar to the Turkish name of the plant *koşkoz* (Davidov & Yavashev 1939; Güneş & Özhatay 2008).

The participants in the field study used only *koskoch*, but the origin of the name remained unknown to them. The tradition was thought to go at least three generations back, with only male family members participating in the “hunting” of blind mole-rats winter stock burials (Fig. 1). All participants sharing the tradition were found to be natives or related to Omarchevo village. The collection of tubers of *L. tuberosum* took place from November to February, before or after the snow cover was formed.

The entrances of the blind mole-rat tunnels are located in the fallows, on forest margins, near field



Fig. 1. Area recognized for gathering of koskoch (*Lathyrus tuberosus*).

Map source: Google Earth Pro 7.3.6.9345 (2023), Location 42°30'31.46" N / 26°07'27.29" E.

boundaries, along irrigation canals and water bodies. Sharpened stakes are used to open the burials and the neighboring spots should be searched immediately so as to prevent transfer of the stocks to a different place. The collected tubers are transferred to specially prepared dug-outs in the home yards, where the tubers are stored to prevent their drying before cooking.

Tubers of *L. tuberosum* are selectively harvested from the burials so as to obtain larger, ready-to-cook tubers. Other stored plant parts/organs (e.g., *Ornithogalum* sp. bulbs, roots of *Angelica* sp. and of members of *Pooideae* subfamily) are left undisturbed, the way they are sorted by the animals. Although the participants know the sites where the species grows, they consider it more effective to track the rodent burials during time suitable for collection (after the decay of the above-grown biomass) than to roam around the fields.

Nowadays, that tradition has been in decline due to a number of factors affecting the accessibility of open fields, limited suitable sites and nutrition base available to blind mole-rats, and none the less, the declining pop-

ulation of the village (Table 1). Consolidated monoculture fields that prevail in the Sliven province lowlands are now exclusively used for such non-irrigated crops like wheat, barley and rapeseed, and less frequently sunflower and corn. These crops are preferred by local farmers because of the state subsidies and lower labor input than the required for orchards or vegetable cultivation. Demolition of the regional irrigation canal system in the 1990s has entailed total abandonment of crops that require regular irrigation and frequent deep tillage of the farmland additionally disturbs wild fauna.

In the past, when sugary foods were rare delicacy, *koskoch* tubers were valued by adults and children as sweets, especially around the Christmas - New Year's festivities. Cooking was cited as the only way to make *koskoch* sufficiently palatable and safe to eat. *Koskoch* tubers have been regarded as a sweet snack and breakfast food, or a comfort food that brings memories from the past, particularly for seniors who participated in the "hunts" in their adolescent years. Currently, the respondents have been reluctant to consume tubers from areas where large amounts of agrochemicals were used. Some of the participants were convinced that the tubers contain toxic compounds that could be eliminated with by prolonged cooking of the tubers.

Discussion

Adoption of a more environmentally-friendly and nature-inclusive approach to agriculture is considered of primary importance so that humankind would halt and possibly to revert loss of biodiversity and habitats. While keeping of the traditions based on gathering of

Table 1. Transformation of traditional practice *Lathyrus tuberosus* collection.

Transformation of land use after early 1990s	Consequences
Land consolidation / Land renting	Limited accessibility to the fields Large monoculture blocks
Demolition of irrigation canal system	Selection of crops that do not require irrigation
Deep tillage	Loss of habitats suitable for <i>Nannospalax</i> sp Reduced weed / ruderal plant diversity
Changes in usual crops and cultivation practices (<i>Brassica napus</i> L. for rapeseed oil)	Avoiding sites treated with agrochemicals

wild edible plants is thought outdated, especially in the industrialized societies, it is important to consider their importance not only for access to more diverse and affordable foods but also as an alternative means to improve soil fertility and to expand the variety of agri-food products on the market (Desheva & al. 2016; Florek & Gazda 2021; Țiței & Cozari 2023). Furthermore, rhizomes, tubers, and other overgrown parts of the plant root system are an part of the overwinter stores of different animals, not only the blind mole-rats (Lingis 1979; Hoffmann & Haberl 2023). The latter are an important component of the diet of many birds and mammals and currently are seldom found in the Thracian Lowland (Zidarova & Kostova 2021). Tradition described in the present study relies on sufficient nutritional winter stores of the blind mole-rats and could be broadened by targeted cultivation of tubers as a green fertilizer. Usage of green manure crops is a relatively new practice in Bulgarian agriculture and has been adopted as a State-supported agroecological measure only in 2023 (Dinev & Mitova 2018; Kachova & al. 2018; MAF 2023). However, the range of the leguminous green manure crops approved by the Bulgarian Ministry of Agriculture and Foods is limited (i.e., *Cicer arietinum* L., *Glycine max* (L.) Merr., *Lotus corniculatus* L., *Lupinus* sp., *Onobrychis viciifolia* Scop., *Phaseolus vulgaris* L., *Vicia ervilia* (L.) Willd., *Vicia lens* (L.) Coss. & Germ., *Vicia sativa* L.). Crops permitted as fodder plants for wild animals are even fewer in number and include only cereals. *Lathyrus sativus* is the only species of the genus mentioned for use as soil-beneficial crop, but only in orchards (MAF 2023).

While some other *Lathyrus* species, namely *L. sativus*, contain higher levels of sugars in the herbage, the tubers of *L. tuberosus* have been shown to contain more than 20% of protein (Hossaert-Palauqui & Delbos 1983; Solovyeva & al. 2020). Thus, the tubers could be used for production of protein-rich plant-based foods, that are currently popular on the market, not only due to their eco-friendliness but also for their functional properties (Tan & al. 2023). Additionally, *L. tuberosus* is known as a successful fodder crop even on soils with high salinity (Smýkal & Erdős 2020). Our participants have been apprehensive about

toxicity of the *koskoch* tubers. Nonetheless, there is no available information that other parts than seeds of the *Lathyrus* species do contain ODAP and this calls for future investigations (Günthardt & al. 2018).

Conclusions

Traditional consumption of *L. tuberosus* in Bulgaria was found to be related to the presence of blind mole-rats, which declines due to changes in land use and management: consolidation, preference of monocultures, destruction of the irrigation systems, and not in the least, the demographic problem. Some incentives to stimulate the cultivation of *L. tuberosus* and other leguminous crops would be useful not only for maintaining soil fertility through green fertilization but also for the production of protein-rich foods based on local traditions, while contributing to sustenance of biodiversity.

Acknowledgements. The authors express their gratitude to the participants in the interviews, who have shared their knowledge.

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