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Univerza
v Ljubljani

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fakulteta
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ZBORNIK REFERATOV

5. SLOVENSKEGA SADJARSKEGA KONGRESA Z MEDNARODNO UDELEŽBO

KRŠKO, 17. – 18. JANUAR 2024

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PHYTOCHEMICAL CHARACTERISATION OF THE SOROSES OF THE OLD LOCAL MULBERRY GENOTYPES AND REINTRODUCTION OF MORICULTURE IN SLOVENIA WITH THE AIM OF DIFFERENT USES IN AGRICULTURE

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ABSTRACT

The white mulberry (*Morus alba* L.) origins in south and south-western China where it has been widely cultivated for more than 4500 years mainly because its leaves are used in sericulture to feed the caterpillars of the silk-producing insect *Bombyx mori* L. (Lepidoptera). The white mulberry was brought to Europe in the 11th century together with sericulture and over centuries became an integral part of the landscape, bearing witness to the sericulture past activity. The old local cultivars are a valuable genetic resource best adapted to specific climatic conditions, which can significantly contribute to sustainable mulberry cultivation. In European countries, mulberry is mainly grown for fruit production, but in various parts of the world, it is also used as leaf production for livestock feed. The various parts of the mulberry plant are said to have a variety of medicinal effects. In addition, bark fibres have been used for the production of paper and textiles since ancient times. Compared to other horticultural crops, where great progress is being made in breeding new genotypes with the help of chemotype markers, research on mulberries is insufficient worldwide. The article reviews the current state of mulberry research focusing on the inventory of old local mulberry genotypes and the metabolite screening of soroses and their organoleptic properties. The exchange of information about mulberry germplasm and the utilization of its genetic resources at the European level is one of the goals of the Aracne project, which is presented in the current review.

Key words: white mulberry, *Morus alba* L., moriculture, phenolics, primary metabolites

FITOKEMIČNA KARAKTERIZACIJA PLODOV STARIH LOKALNIH GENOTIPOV MURV IN PONOVNO UVAJANJE PRIDELAVE MURV V SLOVENIJI Z NAMENOM VSESTRANSKE UPORABNOSTI V KMETIJSTVU

POVZETEK

Bela murva (*Morus alba* L.) izvira iz južne in jugozahodne Kitajske, kjer njeno listje za krmo sviloprejk (*Bombyx mori* L.) pridelujejo že več kot 4500 let. Belo murvo so skupaj s svilogojstvom v Evropo prinesli v 11. stoletju. Murve so skozi stoletja dale značaj kulturni krajini in postale nepogrešljiv del naravne dediščine kot živi spomenik svilogojstva. Stari lokalni genotipi predstavljajo dragocen genetski vir ker so najbolje prilagojene specifičnim

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klimatskim pogojem in pomembno prispevajo k trajnostni pridelavi murv. V evropskih državah se murva goji predvsem za pridelavo plodov, v različnih delih sveta pa se prideluje listje za krmo živali. Vsi deli imajo dokazano raznolike zdravilne učinke. Poleg tega so vlakna iz lubja že od nekdaj uporabljali za izdelavo papirja in oblačil. V primerjavi z drugimi hortikulturnimi rastlinami, kjer je bil narejen velik napredek pri žlahtnjenju novih sort s pomočjo kemotipskih označevalcev, je raziskav na murvah v svetovnem merilu premalo. Članek daje pregled nad trenutnim stanjem raziskav murv, usmerjenih v popis starih lokalnih genotipov murv ter preučevanje metabolitov plodov in njihovih organoleptičnih lastnosti. Izmenjava informacij o genskem materialu murv in uporaba genskih virov murve na evropski ravni je eden od ciljev projekta Aracne, ki je predstavljen v tem preglednem članku.

Ključne besede: bela murva, *Morus alba* L., morikultura, fenoli, primarni metaboliti

1. INTRODUCTION

The white mulberry tree (*Morus alba* L., Moraceae) originates from China and adjacent regions of Central Asia, where it has been widely cultivated for more than 4500 years since the leaves are harvested to feed the monophagous silkworm (*Bombyx mori*) that was domesticated from a wild relative, *Bombyx mandarina* (Altman and Farrell, 2022; Gurjar *et al.,* 2018). In the 12th century, during the 2nd Crusade, white mulberry was brought to Europe from Sicily in order to establish a functioning European sericulture (Vijayan *et al*., 2014). The cultivation of white mulberry trees and associated sericulture was introduced to the Gorizia region during the 16th century from Friuli-Venezia region. This influence has later spread throughout the former Austro-Hungarian Empire. Nurseries accelerated mulberry propagation and offered trees throughout the empire, while silkworm rearers were subsidized by the state program. The 18th century is known as the "golden age" of Gorizian sericulture. In Gorizia, the government set up a magistracy for silk manufacturing, directly subordinated to Vienna (Deutsch, 1909; Žontar, 1957; Ipavec, 2008). After the first half of the 20th century, sericulture in Europe experienced a decline. In recent years, however, interest in sericulture has increased and offers the potential for a sustainable agricultural industry. The European Horizon project ARACNE is aimed at creating a wide and well-connected Silk Innovation Ecosystem that, starting from the historical path followed by Marco Polo in his travels to the East, and also including the routes of production and commercialization of silk in Europe in the following centuries. One of its goals is to carry out an inventory of old local mulberry genotypes in Europe that were traditionally used to feed the silkworms and to record their morphological and genetic characteristics (ARACNE, 2023).

The classification of mulberry genotypes is very difficult and unreliable when based solely on morpho-phenological traits due to their naturalization (Brus, 2004; Vijayan *et al.,* 2014). Wide variations in leaf morphology are observed among different species and accessions. Furthermore, the shape of the leaf may vary according to the age of the plant, growth, position in the branches, and period of growth. The colour of the fruits is not a reliable character to identify mulberry species, since it varies greatly from white to black with different colour shades during ripening (Urbanek Krajnc *et al*., 2023). The phylogeny of mulberries is also difficult, as they show different sex types, monoecious or dioecious, with sex expression varying among species and genotypes Furthermore, different cytomorphs are available in mulberry, from mainly diploid *Morus alba* to docosaploids *Morus nigra* (Vijayan *et al*., 2014).

From a genetic perspective, old trees are crucial because they represent a gene pool that comprises planned and spontaneous selection over many generations. The inventory of old mulberry trees is of high priority in order to preserve their genetic resources for future generations. The main problem of these old trees is their very weak response to propagation processes, which is necessary to obtain future generations.

Ancient trees are ecologically very important organisms. They affect the water regime, carbon storage, nutrient cycling in the environment, and the microclimate regime. Old trees also are also a habitat for many other species. They are also related to the ethnological, historical, and socio-cultural heritage of a certain region. The mulberry is an extremely sustainable and versatile tree species, which, in addition to growing leaves to feed silkworms and livestock, can be used for many other lesser-known purposes, such as the production of mulberry tea and the extraction of cosmetic and medicinal products from the leaves, the production of technical products from wood and wood residues, fruit processing, production of dyes, soil phytoremediation, planting against erosion, and spatial planning in the agricultural landscape in and urban environment (Sánchez, 2000; Jian *et al*., 2012; Liu and Willison, 2013; Xueping *et al*., 2016; Sfiligoj Smole *et al*., 2019; Tikader and Vijayan, 2018). The importance of mulberry trees in providing ecosystem services and their role in landscape and production systems is summarised in Figure 1.

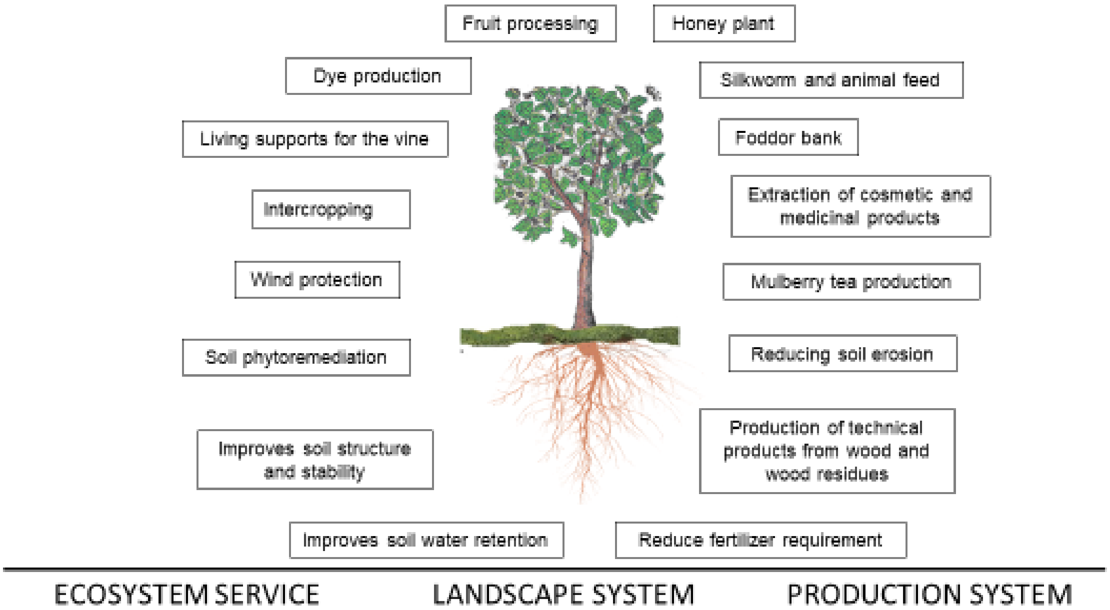

Figure 1: Overview of the ecosystem service, landscape, and production system of mulberry trees
Slika 1: Pregled ekosistemskih storitev, vloge v krajini in možnosti pridelave in predelave murve

White mulberry is a rich source of naturally occurring chemical constituents and has a long history of use in traditional medicine, as its leaves, bark, and fruit are utilized for their various therapeutic properties (Dadhwal and Banerjee, 2023). Biochemical analyses of different parts of the mulberry revealed the presence of phenolics (phenolic acids, flavonoids, and tannins), alkaloids, saponins, and polysaccharides, which are responsible for diverse pharmacological activities (Younus *et al.,* 2016). For the most efficient use of mulberries, it is important to select and propagate mulberry genotypes that have the most desirable characteristics for the planned commercialization.

2. A BRIEF PHYTOCHEMICAL EVALUATION OF MULBERRY INFRUCTESCENCES

Soroses are small, multiple sweet infructescences that consist of a group of drupelets with remnants of the perianth (Łochyńska, 2015). The colour of the soroses is not a reliable distinguishing feature between mulberry species, as they show colours ranging from yellowish-white to pink, dark red, and black, with different shades as they ripen (Kadri *et al*., 2021). The infructescence shape varies from globous to cylindric and asymmetric (Urbanek Krajnc and Kozmos, 2023). The main bioactive compounds of mulberry soroses are primary metabolites, e.g., sugars, organic acids, and proteins, which reach values of 1.44 g/100 g (Sanchez-Salcedo *et al*., 2015; Yuan and Zhao, 2017; Farahani *et al*., 2019), higher than most berry fruits (Giampieri *et al*., 2012; Kaume *et al*., 2012). Numerous studies have demonstrated the presence of various bioactive compounds in mulberries, such as flavonoids, carotenoids, vitamins (A, B, E, K), polysaccharides, fatty acids, minerals, melatonin, and certain alkaloids (Natić *et al*., 2015; Yuan and Zhao, 2017). Consumption of mulberry fruits has been associated with a lower risk of several chronic diseases such as cardiovascular and neurodegenerative diseases, certain cancers, diabetes type II, and osteoporosis (Zafar *et al*., 2013; Velderrain-Rodriguez *et al*., 2014; Yuan and Zhao, 2017).

Genotype is the most important factor in determining fruit chemical composition and antioxidant capacity (Eyduran *et al*., 2015). The very long period of mulberry cultivation has led to the emergence of genotypes with different fruit characteristics through agronomic selection (Macflot, 1776; Hlubek, 1850; Bolle, 1896, 1908; Sakar *et al*., 2023). Currently, there is little data on the nutraceutical characteristics of white mulberry fruits in Europe (Donno *et al*., 2015; Negro *et al*., 2019; Tinebra *et al*., 2021), apart from the recently published study by Truzzi *et al*. (2024), which analysed different mulberry cultivars from the germplasm collection of CREA Padua, representing the pomological diversity in Italy in terms of fruit maturity. As relatively few studies deal with the characteristics of mulberries regarding important metabolites, this leads to insufficient selection criteria.

In a recently published article (Urbanek Krajnc et al., 2023), the main primary metabolites and phenolics were evaluated in soroses of selected local mulberry genotypes, as well as other sericultural and fruit genotypes from the mulberry collection, to determine how colour types differ and which metabolites are the most important distinguishing markers of the colour category. The main sugars identified were glucose and fructose, while the predominant organic acids were citric and malic acids. Considering the variation of their amounts among colour categories, citric acid was higher in the darker cultivars, and fumaric acid, which were highest in the lighter cultivars.

Acidity, which plays an important role in the perception of fruit quality, influences not only the sour taste of the fruit, but also the sweetness, by masking the taste of the sugar. The proportions of the individual acids are also important. The different taste of the yellowish-white and the light pink soroses is influenced by the higher contents of fumaric acid, which is considered to be more astringent than citric or malic acid (Urbanek Krajnc *et al*. 2023).

A total of 42 phenolic compounds were identified in mulberry fruits. The predominant phenolic acid was chlorogenic acid, followed by other caffeoylquinic and coumaroylquinic acids (Urbanek Krajnc *et al.,* 2023). Due to the high content of chlorogenic acid, mulberry fruits have many positive health benefits. The antioxidant properties of chlorogenic acid have been demonstrated in numerous studies, as well as the ability to induce cardioprotective effects, anti-tumour activity, and even neuroprotective effects (Heitman and Ingram, 2017).

The most abundant flavonoids in mulberry fruits are anthocyanins, followed by flavonols (quercetin and kaempferol glycosides), flavanols (catechin, epicatechin, and procyanidins), flavanones, which are represented by naringenin derivatives, laricitrin hexoside, and quercetin rhamnosyl-hexoside. Quercetin derivatives were the most diverse phenolic group, showing a significant increasing trend in their content from yellowish-white to black soroses, except for quercetin malonylglucoside, which showed the opposite trend and was significantly lower in the black colour soroses. The predominant compound was quercetin-3-rutinoside, followed by quercetin malonylglucoside, quercetin-3-glucoside, quercetin-rutinoside hexoside (morkotin A), quercetin rhamnosyl-hexoside, quercetin dihexoside, quercetin-3-galactoside, quercetin-3-xyloside, and quercetin (Urbanek Krajnc *et al*., 2023).

The diversity of colours of white mulberry soroses is an interplay of qualitative and quantitative differences of anthocyanins (Aramwit *et al*., 2010; Truzzi *et al*., 2024), which we found below the detection level in yellowish-white soroses, and increased gradually by more than 100 times from light pink (28.6 mg/kg FW), purple-brown (101.3 mg/kg FW), reddish-black (1400.1 mg/kg FW), to black coloured genotypes (2509.5 mg/kg FW), which is in agreement with other authors (Song *et al*., 2009; Chen *et al*., 2022; Truzzi *et al*., 2024). The predominant anthocyanins were cyanidin-3-glucoside and cyanidin-3-rutinoside.

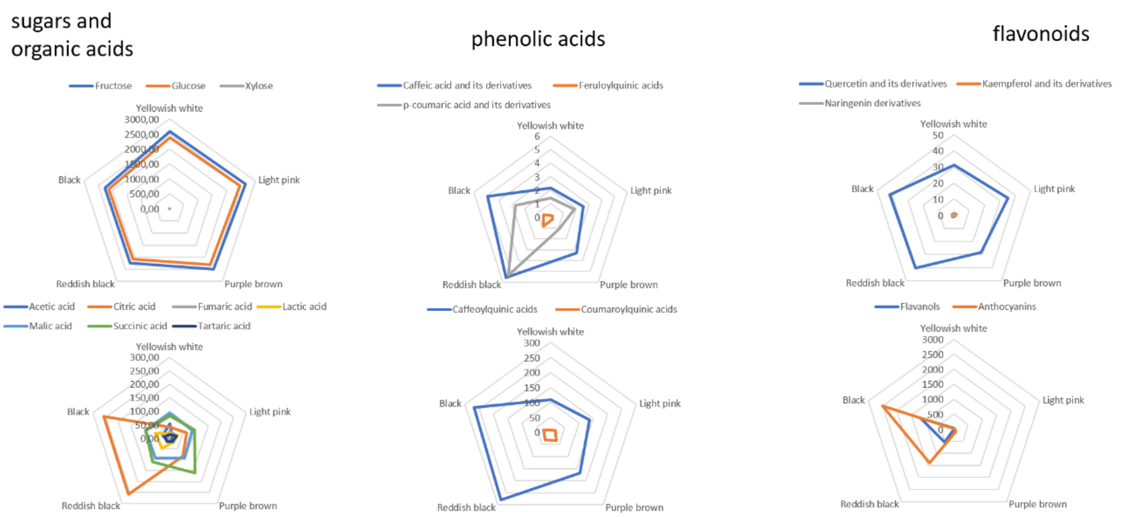

Figure 2: Chemotype characteristics of five different infructescence colour groups represented as radar charts. Mean sugar and organic acid contents are represented in mg/100 g FW, whereas mean phenolic contents are defined in mg/kg FW
Slika 2: Grafični prikaz biokemijske sestave pet različnih barvnih skupin soplodij murv. Povprečne vrednosti za sladkorje in organske kisline so izražene v mg/100 g sveže mase in za fenolne spojine v mg/kg sveže mase

According to Figure 2, the colour types showed a clear chemotype character. The sweet taste of the yellowish-white soroses was defined by 2586.60 mg/100 g FW of fructose, followed by 2384.30 mg/100 g FW of glucose and 321.83 mg/100 g FW of organic acids. The sour character of the black mulberry genotypes was characterised by a lower sugar (2273.20 mg/100 g FW of fructose and 2124.59 mg/100 g FW of glucose) and higher organic acid content (548.44 mg/100 g FW of total organic acids). The colour-dependent effect was observed in the proportion of phenolic acids, which were highest in darker soroses, defined by 280.11 mg/kg FW of caffeoylquinic acids, 30.89 mg/kg FW of coumaroylquinic acids, 5.59 mg /kg FW of caffeic acid and 5.37 mg/kg FW of coumaric acid derivatives. In black-coloured soroses, quercetin derivatives reached levels of 41.65 mg/kg FW, total flavanols 1172.30 mg/kg FW, and anthocyanins 2509.49 mg/kg FW (Figure 2).

3. MULBERRY PROPAGATION AND CULTIVATION

To maximise the efficiency of mulberry cultivation, it is important to select and propagate mulberry genotypes that have the most desirable characteristics for the planned commercialization. Mulberries of selected genotypes can be propagated generatively by green and hardwood cuttings, grafting, and marcotation (Lim, 1990; Petkov *et al*., 2004; Grekov *et al*., 2005; Tzenov and Grekov, 2010; Pirc, 2015; Brion, 2016; Grekov *et al.,* 2020).

The very long period of mulberry cultivation has resulted in genotypes with different fruit characteristics through agronomic selection, as in the past mulberries were mainly propagated by gamic propagation and grafting of high-yielding genotypes, which has increased diversity (Macflot, 1776; Hlubek, 1850; Bolle, 1896, 1908).

The propagation and grafting techniques were described in detail in the manuals of the 18th and 19th centuries (Macflot, 1776; Hlubek, 1850; Bolle, 1896, 1908). The seeds were obtained from fully ripe mulberry fruits, dried and stored for spring sowing in the following year. After two years, the seedlings are robust enough for grafting, which takes place on dry days from mid-March to the end of April, with shield budding or splice grafting being favoured.

For the last 70 years, mulberries have been propagated mainly by hardwood cuttings in early spring. The shoots are cut in January or February with a diameter of 1 cm and a length of approx. 20 cm. The shoots are treated with IBA at the base and sealed with wax at the top. The cuttings are planted in perlite by heating the beds with electric wires that maintain a temperature of 24-26 °C. The air temperature during the maintenance of the cuttings must be below 18 °C (Petkov *et al*., 2004; Grekov *et al*., 2005; Tzenov and Grekov, 2010; Brion, 2016; Grekov *et al.* 2020).

Recently, we have established a protocol for the propagation of green cuttings in early summer, using semi-soft, annual shoots with a diameter of about 5-8 mm. Cuttings with 3-5 nodes are prepared and soaked in 1% IBA. The cuttings are kept in a well-drained substrate mixed with perlite in a fogging system. See Figure 3 for the detailed procedure.

For sericultural use, after one year the saplings are cut back to a height of approx. 1 m and then replanted. The mulberry trees are pruned in a Friulian approach, creating a container-like tree shape that allows light and air to pass through, making to the collection of leaves easier. Pruning promotes faster growth and tree sustainability. The main objectives of pruning are to maintain a horizontal tree crown, to favour high-quality foliage over fruit production, and to promote tree growth and longevity (Bolle, 1896; Pirc, 2015; Brion, 2016). For fruit production, a medium or high pruning form with a distance of 7 meters between trees is preferred (Pirc, 2015).

During the inventory of mulberry trees in various regions of Slovenia and Hungary, shoots of historical trees were taken for propagation in order to establish a mulberry collection and to study the genetic and biochemical characteristics of the existing mulberry gene pool (Urbanek Krajnc *et al*., 2019; Šelih *et al*., 2020; Urbanek Krajnc *et al*., 2022).

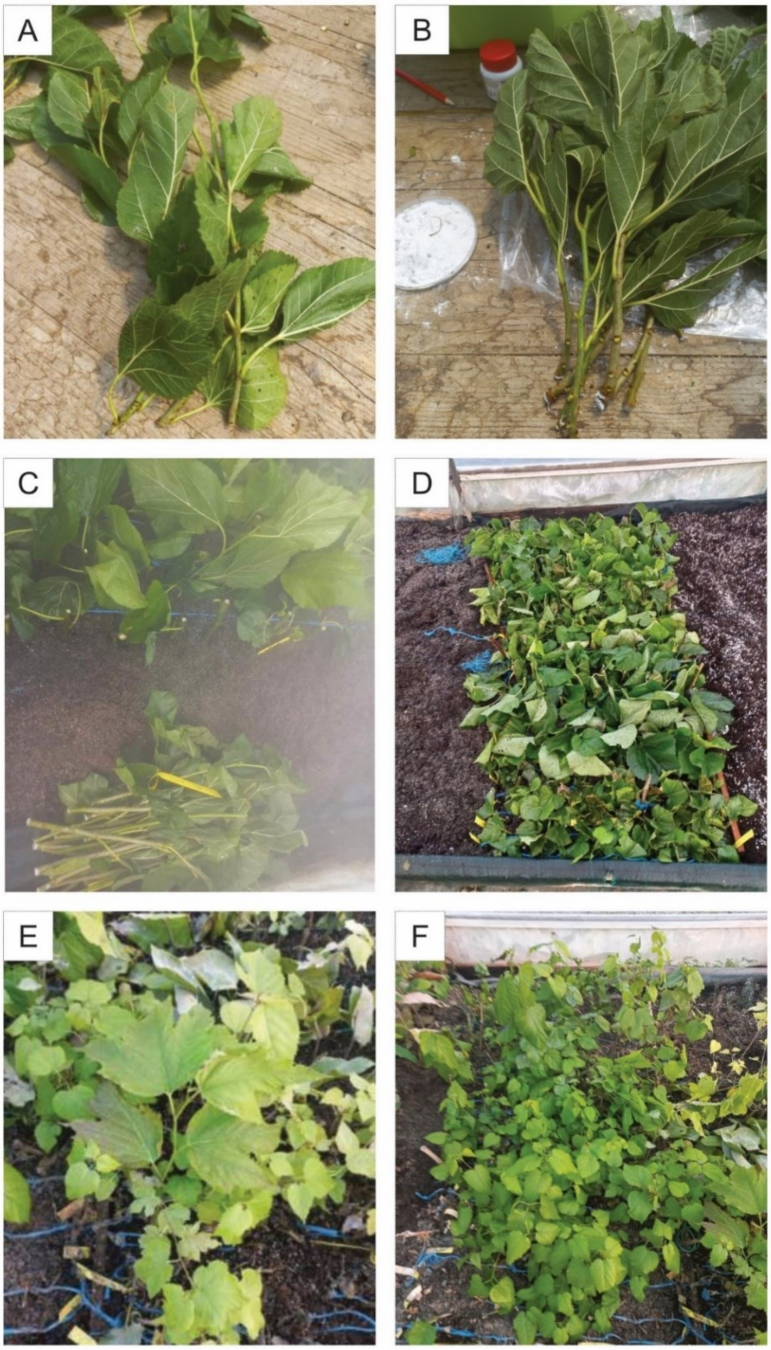

Figure 3: Preparation of green cuttings obtained from old local Slovenian genotypes in early summer. A) Current-year shoots. B) Preparation of three- to five-node cuttings and treatment with IBA. C) Planting of cuttings into the prepared substrate mixed with perlite. D) Bed with cuttings comprising different genotypes. D) Detailed photo of well-developed cuttings in autumn. E) View over the bed in autumn, showing the growth success of cuttings
Slika 3: Priprava zelenih potaknjencev pridobljenih iz starih slovenskih genotipov v času zgodnjega poletja. A) Enoletni poganjki. B) Priprava tri- do pet-nodijskih potaknjencev. C)

Sajenje potaknjencev v substrat. D) Fotografija primerno razvitih potaknjencev v jesenskem času. E) Greda v jesenskem času z uspešno razvitimi potaknjenci različnih genotipov.

The mulberry collection under Vila Pohorje is divided into three parts. The first part consists of the old mulberry genotypes, which originate from the gene bank of the Sericultural Institute in Padua and are mainly grown for the production of foliage. They are characterised by large leaves, fast growth, and high production of leaf biomass. In addition, we grow vegetatively propagated trees derived from the local historical Slovenian and Hungarian trees obtained during the sampling excursions. The third part of the collection is intended for the cultivation of new fruit-bearing genotypes suitable for fruit processing (Figure 4).

Figure 4: Mulberry collection at the Faculty of Agriculture and Life sciences. A) View of the collection with local Slovenian and Hungarian, as well as reference sericultural and fruit cultivars. B) Young local genotypes' trees in year 2018. C) Local Hungarian genotypes with soroses characterized by prolonged ripening
Slika 4: Kolekcija murv Fakultete za kmetijstvo in biosistemske vede UM. A) Pogled na kolekcijski nasad s starimi slovenskimi in madžarskimi genotipi ter sadnimi kultivarji. B) Mlada drevesa lokalnih genotipov murv leta 2018. C) Drevo lokalnega madžarskega genotipa za katerega je značilno podaljšano zorenje soplodij

4. PREVIOUS ACTIVITIES RELATED TO THE MULBERRY RESEARCH AND SERICULTURE IN SLOVENIA

Research activities related to mulberries began with the joint Hungarian-Slovenian project in 2015, which was based on the assessment of existing genetic resources of historical mulberries in Slovenia and Hungary, the establishment of collections, the identification of important metabolites in the leaves and the examination of their importance for the development and health of silkworms (Urbanek Krajnc, 2019).

During the inventory of mulberry trees in different regions of Slovenia and Hungary, shoots of historical trees were taken for propagation in order to establish a mulberry collection and to study the genetic and biochemical characteristics of the existing mulberry gene pool. Screening of metabolites in the leaves allowed us to define superior genotypes of the local gene pool that have already proven their potential as fodder (Urbanek Krajnc *et al*., 2019; Šelih e*t al*., 2020; Urbanek Krajnc *et al*., 2022).

The analyses of leaf metabolites allowed us to highlight the most suitable distinguishing characteristics, further define morphotypes, and present correlations between measured parameters in terms of potential leaf harvest-related pruning management (Urbanek Krajnc *et al.* 2019, Šelih *et al.*, 2020). All genotypes included in these morphometric and biochemical analyses were part of a broader study aimed at defining high-yielding and more nutritious mulberry cultivars from the local gene pool selected for the silkworm feeding experiment (Urbanek Krajnc *et al*., 2022) to study how old mulberry leaves affect silkworm growth, health status, and cocoon quality.

Positive correlations were found between total proteins and kaempferol derivatives and silk threat parameters (i.e. length and weight). The study revealed that the selection of mulberry genotypes for silkworm rearing from the local gene pool based on leaf proteins, specific phenolics, and mineral components is very important to optimise larval development, cocoon production, and raw silk parameters. We were also able to identify Slovenian and Hungarian genotypes with better raw silk parameters.

With the aim of analysing the potential of using mulberries, we brought together students from various study programmes at the Faculty of Agriculture and Life Sciences and the Faculty of Natural Sciences and Mathematics of the University of Maribor, as well as mentors from the research fields of botany, geography, chemistry, and computer science as part of the project On a Creative Path to Knowledge (Urbanek Krajnc, 2017). We have created digital maps of mulberries and a website (murve.um.si) to raise awareness of the systematics and importance of mulberries.

As part of the EIP-AGRI project entitled “Introduction of new mechanical and autonomous automated technologies for sustainable grape production in vineyards” (Berk *et al.,* 2023), we have planted various local mulberry genotypes to strengthen biodiversity and thus ecosystem services in vineyards. We have experimentally planted mulberries in the slopes and terraces of the vineyards to reduce erosion and investigate the phytoremediation potential of mulberries in relation to pesticide residues in the vineyard. The socio-economic benefit is the preservation and revitalisation of old Slovenian mulberry genotypes and traditional orchards in the former sericultural regions. The socio-economic benefit is the preservation and revival of old Slovenian mulberry genotypes and traditional orchards in the former sericultural regions.

5. REBIRTH OF THE SILK INDUSTRY: THE START OF THE HORIZON EUROPE PROJECT “ARACNE”

In March, the University of Maribor started the implementation of the European Horizon project in the field of revival of European cultural heritage under the coordination of CREA Agriculture and Environment (Consiglio per la Ricerca in Agricoltura e l'Analisi dell'Economia Agraria), Italy.

The project’s acronym ARACNE stands for "Advocating the Role of silk Art and Cultural heritage at National and European scale". The acronym name is inspired by the weaver transformed into a spider by the goddess Athena in Greek mythology. The overarching goal of ARACNE is to create a wide and well-connected Silk Innovation Ecosystem that, starting from the historical path followed by Marco Polo in his travels to East, that includes the routes of production and commercialization of silk in Europe. An innovation ecosystem is an interconnected network of quadruple helix stakeholders, including academia, industry and different levels of the public sector and civil society.

The project is carefully implemented by 6 universities and research centres, 3 museums, a cultural association, a cultural foundation, 2 cultural and creative smart media enterprises, a consulting company for finance and innovation, and an international organization, including 7 partner countries (Italy, Spain, France, Slovenia, Greece, Bulgaria, and Georgia), which are connected by the cultural and historical identity of sericulture. Under the coordination of the University of Maribor, the Faculty of Agriculture and Life Sciences, the Faculty of Mechanical Engineering, and the Faculty of Electrical Engineering and Computer Science are members that participate in aforementioned project. At the Department of Botany and Plant Physiology (Faculty of Agriculture and Biosystem Sciences -FKBV), we are focused on the inventory and the morphological and genetic research of local mulberry genotypes of partner countries, in order to follow the ancient route of mulberry spreading from Asia to Europe. Old local genotypes with good morphological characteristics will be propagated and made available to local communities. The aim of the research is to re-introduce mulberries into the cultural landscape and raise awareness among the general public about the important ecological benefits of planting mulberries.

The Institute of Textile Materials and Design of the Faculty of Mechanical Engineering (FS) and the Institute of Automation of the Faculty of Electrical Engineering and Computer Science FERI) participate in the ARACNE project from the point of view of technological innovations.
Design, development and fabrication of new materials from silk and silk processing waste will be carried out using several advanced production techniques, such as electro-spinning and 3D printing, which will transform fibroin and sericin as silk components into bulk structured materials, i.e. nano-fibrous webs and 3D objects, respectively. Pertaining to the circular economy concept, we will employ natural mulberry-based phenolic molecules to develop functional particles and coatings, that will confer new or enhanced properties to silk-based products as UV shielding or dyes. In this context, we will deal with the relationship between silk-society-history and the innovative design of various silk products.

The Institute for Media Communications (FERI) is involved in the ARACNE project as support for research about the heritage and history of sericulture in Europe, within the framework of which a visual catalog will be produced.

The ARACNE project focuses on the cultural heritage of European silk production and its preservation, protection, and evaluation. The goal is to revive traditional skills based on the common cultural and artistic heritage with the aim of reshaping the European cultural identity related to silk, which will be the common basis for the new European Silk Road. The intention is to create a wide and well-connected network that would stem from the historical route of Marco Polo and include the routes of silk production and trade in Europe. As part of the project, we strive to bring silk production back into vogue by reconstructing a resilient and innovative ecosystem, which will be based on tradition, architecture, and the tangible and intangible heritage of the silk regions. The project aims to improve the competitiveness of European silk-related cultural and creative industries by jointly developing silk-based products, processes, and innovation services using digital applications and state-of-the-art technologies and by transitioning to more sustainable business models. Furthermore, we want to redraw the European Silk Road by connecting and joining activities between European cities and regions with a past in sericulture and silk-making history. The project strengthens European cultural identity and represents an important contribution to the European Green Deal and the Sustainable Development Goals (ARACNE, 2023).

6. CONCLUSION

This article underlines the need to preserve mulberries as a historical remnant of sericulture in the context of traditional and rational use in agriculture, as we have found that mulberries are undergoing dramatic genetic erosion due to the abandonment of sericulture cultivation and agricultural land. Through a review of existing genetic resources and the establishment of the collections, we have highlighted the natural, cultural, and scientific value of the white mulberry.

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5. SLOVENSKI SADJARSKI KONGRES Z MEDNARODNO UDELEŽBO

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