Chapter 26
Significance of Medicinal Plants in Medzibodrozie Region, East-Southern Slovakia, for the Socio-Economic Stability of Rural Areas

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Abstract The main aim of the European Agricultural Model is to develop prosperity in the countryside. The model supports traditions, environment, and economic welfare. The agricultural business and management of land are focused on alternative crop production, enviro- and social-activities. This model is applied to Medzibodrozie region in East-southern Slovakia, which is created by the Tisa, the Latorica, and the Bodrog rivers (418 km^2 and 38,100 inhabitants). Several possibilities for expanding the agricultural production of the Medzibodrozie region are the cultivation of medicinal plants such as poppy, small fruits, energetic crops, and crops with tourist interest, e.g. the Tokay Wine Region. These agricultural activities have importance from several points of view: (1) rational (offering appropriate job opportunities for unemployed people), (2) production (better utilization of marginal land resources, e.g. salty soils, lower-quality soils in sub-mountainous or mountainous areas), (3) economic (from the viewpoint of market value the medicinal plants belong to the most effective crops), (4) environmental (application of bio-pesticides and mineral fertilizer based on natural zeolite), and (5) diversification (widens crop composition by adding the possibility of introducing new plant species with their own unique natural substance compositions).

Keywords Agricultural model · Biodiversity · Countryside · Medicinal herbs · Tourism

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26.1 Introduction

The key objective of the European agricultural model is rural development—creating a coherent and long-lasting context that would guarantee the future of rural areas by promoting the creation and maintaining of jobs, with an emphasis on improving public welfare (Van Meijl et al. 2006).

At present, competitiveness in the primary sector depends on the economic directives that affect business and production decisions only partially. More and more important for the competitiveness of farms and regional systems are the environmental sustainability of production processes, area protection, food safety, and the primary sector's ability to provide environmental services (Otepka and Haban 2007).

European agricultural model supports

- strong commitment to traditions, where the objective of agriculture is not only to produce but also to protect the countryside and active rural communities and to create new jobs,
- strengthening the main rural sectors: agriculture and forestry,
- improving competitiveness in rural areas to provide job opportunities and well-being of people living in the countryside,
- preserving the environment, landscape, and rural heritage in Europe.

Changes in lifestyle increased social sensitivity to the environmental topics, and the quality of agricultural production are elements that offer new opportunities for business units and new tests on the road to the sustainable development of rural areas. The concept of multifunctionality of agriculture is becoming more important and is getting to the fore.

The European agricultural model is based exactly on multifunctional farms, which in addition to the main business activities based on the soil, and focuses on activities in the following fields (Šalamon 2000):

(a) alternative production (medicinal, aromatic and spice plants, herbalism, natural fabrics, and colours), tourist facilities and services-related (agritourism, food tasting, and catering), valorization of typical products, entertainment (hiking, horse riding, and other sports), hunting, cultural activities (local culture and habits demonstration, guided tours), local crafts, and environmental courses;

(b) environmental activities—an active role in actual territorial planning: the production of renewable energy and growing energetic crops, the maintenance and cleaning of sidewalks, trenches, streams, and small lakes, management of abandoned public forests, environmental activities focused on wild animals, preserving and protecting biodiversity, management, and maintenance of public parks and gardens;

(c) social activities (providing social services to citizens)—services at your fingertips: mixed goods shops, transport, post services, home care services, nursing services (day centres for the elders, kindergartens, and schools). These are activities that could be developed by multifunctional rural companies in smaller and larger villages.

26.2 Biodiversity Protection

Biodiversity is especially important for the balance of ecosystems. At the global level, it is threatened by industrial development, urban construction, deforestation, increasing agriculture specialization due to seed market orientation dominated by supranational groups as well as the monoculture trend (Plačková 2007).

Genetic heritage and biodiversity protection are some of the main goals of the development policy of the European Union, representing an excellent opportunity for agricultural companies. Biodiversity protection can be performed (Haban et al. 2007) in two ways:

- production interventions are based on the valorization of the typical and introduction of the cultivation and breeding of such crop and animal species that have been overlooked in recent years, and the introduction of plant production systems with low environmental impact.
- non-production interventions are based on the promotion of environmental improvement actions to improve the reproduction of plant and animal species (e.g. fences renovation and planting of trees, non-cultivated fields to be intended for the feeding of wild animals, etc.). All these activities rely on the EU rural development regulations, supported by subsidies.

26.3 The Area Among Rivers—Medzibodrozie Region

Islands mean an exciting feeling of something exotic, something safe where you can take shelter from the rest of the world. The Slovakia east-southern Island is a small one that is created by the Tisa, the Latorica, and the Bodrog rivers. This has a surface area of 418 km^2 (Fig. 26.1) and a population of 38,100 inhabitants (Midriak et al. 2008). It belongs to the regions with typical identity, nice picturesque landscape, and strong character. From the tourist point of view, the surrounding is not well known as yet.

However, this is the ideal place where visitors can get closer to nature and fulfil their expectations by wandering, riding a horse and a bike, bird-watching, rowing a boat, fishing, and hunting. On the other hand, visitors can make an unforgettable trip by visiting some romantic castles, mansions, churches, taste special dishes prepared from fresh fish and have a drink of regional wine in one of the typical wine cellars.

26.4 Growing of Medicinal, Aromatic, and Spice Plants

One of the possibilities of expanding agricultural production in the Medzibodrozie region is the development of large-scale cultivation of medicinal, aromatic, and spice plants. This special production follows worldwide efforts on improving population

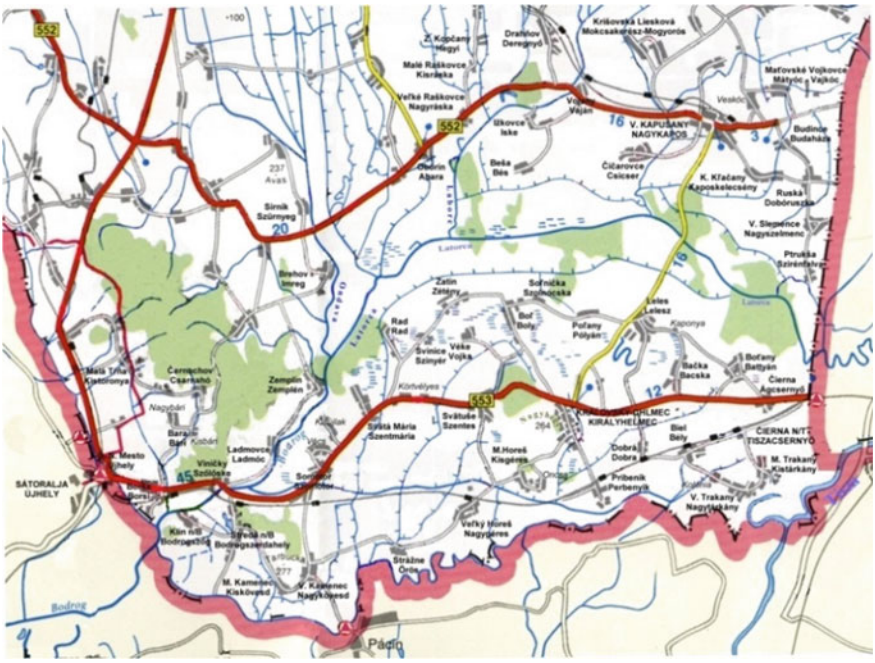

Fig. 26.1 Slovakia east-southern island

health, environmental quality, and biodiversity protection. This agricultural production falls within the sphere of specialized crop production, and it is the only way to ensure the necessary amount of high-quality material for processing and export (Šalamon and Gurková 2006).

Medicinal plant production has several meanings for overall crop production from the view of social aspects (Salamon 2001):

- Production (puts into use the reserves in the soil fund which is not suitable for usual plant production),
- Diversification (widens crop composition by adding the possibility of introducing new plant species with their unique cultivation processes),
- Economic (in terms of revenues, these plants are considered as some of the most profitable crops in agriculture),
- Social (increases employment and provides suitable and interesting job opportunities).

26.4.1 Large-Scale Cultivation of Special Crops

Nowadays, about 150 and 200 medicinal plants are used in official therapy and popular medicine, respectively. The medicinal, aromatic, and spicy plants are mainly

used in this country in phytotherapy, veterinary medicine, cosmetics, and food industry. These plants have additive, ecological, decorative, and sanitary-hygienic functions and positive influence on the water system, soil conservation, plant pasture for bees, phytoadditives, and natural substances (Salamon 2014a).

Large-scale cultivation of medicinal, aromatic, and spice plants can be realized by every agricultural subject on the practically whole area of Medzibrodrozie. The production basis within the principles of sustainable rural development is therefore very wide and has many possibilities to utilize the diversity of agricultural soils and its multifunctional value. This fact has to be always taken into account. On the other hand, herbs come from a wide range of species classified into various botanical families. For this reason why most of these plants are not demanding for particular soil-climatic conditions. The selection and subsequent cultivation of the species are practically unlimited for an agricultural company with an interest in large-scale production (Salamon 2014b).

Every plant species demands special agro-technical processes for large-scale cultivation. In practice, this means that it is necessary to obtain information about seeds germination biology, their subsequent sprouting, and growth, the ontogenetic phases of plant evolution, etc. From these facts, it can be deduced that the elaboration of a cultivation procedure based on the soil-climatic environment conditions is a process requiring a lot of research and experimental works (Salamon 2014b).

Cultivating medicinal, aromatic, and spice plants require an extensive amount of manual labour. Flower collectors and subsequent technology after the material is collected have been developed due to this reason. These machines and equipment have earned the attention deserved not only inland but also abroad.

The development of special crops is mostly limited by the shortage or unsuitable state of the capacities of drying plants in the agricultural subjects, interested in this activity. After minimizing tobacco cultivation areas, there are box dryers in many farms in the region of Medzibodrozie left unused. These could be used to dry these special crops.

An important perspective is mainly in the expansion of non-waste technologies, which means utilizing waste material after herb processing for animal feeding, production of organic fertilizers, and phyto-products used for crop protection. These are the global trends in the complex utilization of grown material, which should also be introduced in our country (Haban 1996).

On the other hand, selling the raw material on EU markets means a very interesting price. If a business partner is satisfied with the quality, then it is about tens of tons of deliveries. Direct profit is multiplied. In most cases, a long-lasting stable business relationship will also be created.

Large-scale cultivation of medicinal, aromatic, and spice plants in the area of Medzibodrozie began in the 1990s. Permanent cultivation areas of chamomile (*Matricaria chamomilla*), pot marigold (*Calendula officinalis*), Moorish mallow, yarrow (*Achillea collina*), red clover (*Trifolium pratense*) (cultivated for flowers), and later marjoram (*Origanum majorana*) (Haban et al. 2001) were annually on an area of 7.5 ha. In connection with the cultivation process and soil-climatic demands of various plant species, the suitability of this environment for production was

confirmed. Mechanization for harvesting and post-harvesting treatment—flowers harvester (type VZR-4), sorting device (type ST-1001), and tobacco dryer modified with pallets (type SIROKO)—was concentrated in the village "Streda nad Bodrogom" (Salamon 2007). Thanks to the use of high-quality races, a high content of therapeutically active ingredients crop was grown and exported abroad (e.g. Australia). The annual volume of funds earned from this special production was up to € 10,000.

26.4.2 Perspectives of New Cultivation Fields

Slovakia is one of the European countries in which particular attention has been devoted to the research of medicinal, aromatic, and spice plants in all its aspects, including the breeding and selection. Based on the study of pharmacodynamics properties of several medicinal crops, the chamomile variety "Lianka" and the peppermint variety "Kristinka" were bred at the University of Presov, Slovakia, between the years 2008–2013. Currently, both varieties have the certificates by the Community Plant Variety Office in Angers, France (No. 49433 and No. 46937). The chamomile variety is characterized by its high percentage of sequiterpenes (/-/-α-bisabolol [52–55%], chamazulene [18–19%], the low contents of /-/-α bisabololoxides A and B [<3%], and essential oil content is from 0.65 to 0.85%). The peppermint variety has very high content the menthol [70–75% of herbs and 80–85% of leaves] of essential oil [2.6%] into the dry raw material. There is a strong premise that the cultivation of these two varieties of medicinal plants throughout the European Union will be expanded in the coming years (Salamon et al. 2018).

Natural products, their derivates, and analogues represent over 50% of all drugs in clinical use, with higher plant-derived natural products providing approximately 25% of the total use (Fery 2002). The commercial value of drug products still derived directly from higher plants is considerable, and plants continue to be important sources of the new drugs and nutrition supplements. It is one way to start a profitable production of new/alternative crops.

New/alternative crops are those which are not normally produced in the Medzibodrozie areas. If the new crop is being transferred from somewhere nearby, at least something about its production techniques and markets may be known. Otherwise, the challenge of new crops is to discover what they produce and how the product can be sold (Salamon 1998).

New/alternative crops are a long term, high-risk adventure into the unknown with the possibility of better returns than current crops, eventually. Indulging in the new crop adventure can be like gambling. One should only gamble what one can afford to lose. As with gambling, the thrill of the high risks involved can be exhilarating. Though leuzea (*Rhaponticum carthamoides*/Willd/Iljin) and puncturevine (*Tribulus terrestris* L.) are introduced crops, these are commercially successful in this area (Salamon 2014a, b).

Both plants are a biogenic stimulant and adaptogenic containing phytohormones which affects the central nervous system. It produces increased physical and psychic

abilities, stimulates tired body muscles, improves the condition, and conciliates demonstration of nervousness, a disorder of insomnia, depression, and disgust. The medicinal attributes of Puncture Vine are due to the furostanol saponins, which have been shown to stimulate increases in natural testosterone levels. Concerning this fact, they are a stimulating effect on the immune, sexual and reproductive systems, with improved muscle building, their tonic action, vigour, vitality, stamina, and physical endurance (Salamon et al. 2006).

26.5 Poppy (*Papaver somniferum* L.) Production and its Heritage

Poppy (*P. somniferum* L.) is an oil plant that has been cultivated in the middle European countries for many years. The main purpose is a seed production used in the food industry, and the second purpose is poppy straw (including capsules), which is an important source for obtaining alkaloids (morphine) for medicinal products in the pharmaceutical industry.

26.5.1 Poppy Cultivation in Eastern Slovakia

Poppy as a traditional crop in the Medzibodrozie region and its production has a long-lasting history, especially to be cultivated in the private gardens. Farmers have preferred a combination of both methods of poppy production: seeds for food uses and dry capsules for the procession in pharmaceutical industry. Areas of poppy production in Slovakia were usually from 386 to 2714 hectares during the last 15 years. The yield of seed during the period was from 0.28 to 0.73 tons per hectare. Good agricultural practice and own registered Slovakian poppy varieties are a very suitable background for high yield potential of poppy seeds production (about 2 tons per hectare) (Fejer and Salamon 2014a).

The breeding and selection of poppy plants in Slovakia date back to 1948, and it was concentrated on the generation of non-specific varieties. The main aim was to find the generation of varieties with the high capacity to accumulate morphine in dry capsules together with high production of good quality blue-coloured seeds used mainly in food industry. Several varieties were registered as the result of long-time selection process with relatively high production potential of blue-coloured poppy seed. There have been already several different varieties of poppy cultivated and grown in Slovakia. Currently, six varieties of poppy with blue-coloured seed are officially registered in Slovakia: “Bergam”, “Gerlach”, Major”, “Malsar”, “Maraton”, and “Opal”. The only variety “Albin” has white-coloured seed. All of them are properly adapted to Central European agro-ecological conditions. The yield of poppy seed of the varieties has been varying from 0.28 to 0.73 t ha^{-1} in the past ten

years. However, the genetic yield potential of poppy seed within these varieties is up to 2.0 t ha^{-1} (Fejer and Salamon 2014b). All of these varieties are suitable primarily for food industry purposes, secondary for medicinal purposes.

Poppy capsules as a by-product or a secondary product of poppy seed production is also very important raw material to use in pharmaceutical industry. The straw yield of poppy within mentioned Slovakian varieties ranges from 300 to 500 kg ha^{-1}. Content of morphine in dry capsules varies between 0.3 and 0.6%. The straw of these poppy varieties is mostly used for morphine extraction; however, it does not meet the increasing demands of the pharmaceutical industry for the product. These varieties are also valued for their good tolerance to herbicides used in the cultivation period. Therefore, they are very suitable for large-scale production of poppy seeds.

Market of poppy straw material ranges between 55.3 and 1591.5 tons annually during the period of 1990–2015. However, real processing capacity of the pharmaceutical industry in Slovakia is much higher: about 4000 tons annually (Seneca Pharmaceuticals, Co. in Hlohovec, West Slovakia). The rest of raw material has to be imported, mainly from the Czech Republic. Actually cultivated varieties of poppy are able to accumulate from 0.4 to 0.6% of morphine. In reality, the marketed straw material contains only 0.3% of morphine in average. The influence of soil characteristics, the weather conditions of actual vegetative season, harvest and post-harvest technologies also affect seed and alkaloid yields.

26.5.2 Breeding and the Content of Poppy Morphine

With the increased poppy cultivation in 1948, breeding works had also begun. At this time, the breeding workstation in Sladkovicovo cooperated with the Slovak pharmaceutical company. Breeding was aimed to higher morphine content in dry capsules and their suitability for mechanized harvest and production of poppy seeds. The selection of new varieties was also realized in other localities of the country (the Eastern parts of Slovakia in Trebisov and Maly Saris).

The first Slovak poppy variety "Blankyt" was registered in 1967. It provided a high yield of blue-coloured seeds. Morphine content in dry capsules reached 0.40%. Since the registration of the first Slovak variety, eight more varieties of blue seeds were bred. They have a high yield potential of poppy seeds (2.0 t ha^{-1}) with the ability to accumulate 0.4–0.6% of morphine in dry capsules (Fejér 2007). The main advantage is their suitability for large-scale technology production. They are adapted to the agro-climatic conditions of Central Europe (Cihlář et al. 2008). Particularly appreciated is their high tolerance to used herbicides when compared with foreign, e.g. the Hungarian and Polish varieties. The variety "Albin" has white seeds and low morphine contents in capsules (around 0.3%). It is used for baking, and its taste reminds us walnuts.

The annual average of poppy straw that Seneca Pharmaceuticals, Co. in Hlohovec handles is 3840 tons (average of 1990–2015). The bulk of raw material was imported from the Czech Republic. Small growing areas in Slovakia are unable to cover their

needs. With 0.301% content of morphine, it is currently necessary to process 5500 tons of poppy raw materials to produce 18 tons of morphine. The actual interest in the varieties able to accumulate high levels of morphine (more than 1.0%) has increased. To obtain sufficient quantities of quality raw materials, several measures have been made. The company implements a variety from Hungary (1995–2002) containing 1.5% of morphine. In some cultivation areas, the Polish variety "Lazur" is grown. This accumulates about 1.0% of morphine. The possibilities of domestic breeding were also looked into. Selected and improved breeding materials can accumulate from 0.9 to 1.1% morphine. Poppy gene pool collection in the Gene Bank in Piestany provides genotypes with the ability to accumulate up to 2.0% or more of the alkaloid (Fejér, unpublished).

Opium poppy (*P. somniferum* L.) cultivation under Medzibodrozie conditions is not only a traditional plant but also a perspective crop in the structure of sowing for farmers. Concerning the existence of a Slovak pharmaceutical company that requires high-quality raw material, it is likely that the cultivation area will increase within the next five years, from 1500–2000 to 5000–8000 ha. A prerequisite for the expansion of poppy cultivation is a suitable variety for poppy straw production.

26.5.3 Using of Poppy Seeds by Households

Poppy seeds are used in many baked goods as a decorative garnish and as a paste of ground seeds. They are used in main course dishes and desserts. They are also the source of poppy seed oil. In Slovakia, seeds are used in various types of breads, cakes, and pastries which are often sprinkled on top with black and white poppy seeds (e.g. strudel, buns with poppy seeds and pastry, "opekance"—round yeast bread with poppy seeds, a traditional meal prepared for the Christmas Eve dinner, and various types of biscuits).

The average consumption of poppy seeds per head in Slovakia, the Czech Republic, and Austria is 300 g. In Germany and the former Soviet Union states, it is about 100 g poppy seeds (Vašák et al. 2010).

In connection with the consumption of poppy seeds, there is a study on possible harm due to the morphine content of the seed. The seeds themselves do not contain significant amounts of alkaloids. It may be contaminated with small particles of poppy straw and thus may show little amounts. Slovak varieties contain low to moderate content of morphine, so contamination is negligible, and consumption is not harmful to human health. Many of Slovak households have been growing poppy for their use in gardens. The law permits the cultivation in the area up to 100 m^2 without permission. After the harvest, the poppy capsules are emptied by Slovak housewives. Impurities are removed by washing with water, and seeds are dried (Fejer 2007).

26.6 Cultivation of Elderberry and Its Anthocyanins

Sambucus L. is a member of the Adoxaceae family. It consist of 5–30 different species of deciduous shrubs, small trees, and herbaceous perennial plants. European (black) elderberry (*Sambucus nigra* L.) has the highest economic importance, and selected natural populations are commonly used and distributed in Europe. This species naturally grows from the lowlands to the sub-mountain level throughout Slovakia. Plants grow in the forests landscape, in bushes, shambles, and near rivers. It is relatively resistant to poor soil, drought, heavy sunshine, and shade. Elderberry production increased from 18 to 77 ha localized in different parts of Slovakia, during 2005–2015. The most used cultivar: "Haschberg" is cultivated almost on 75 ha (e.g. 97%). Only 3% (about 2 ha) of the production area is used for cultivation of the other registered cultivars: "Bohatka", "Dana", "Sampo", and other minor cultivars (Fejer et al. 2015).

The most cultivated cultivar "Haschberg" has been selected in Austria, as a natural resource of anthocyanins. It is a shrub or small tree growing to up to 6–7 m. The trees start to flower in early June and produce a lot of pollen. Cultivar "Haschberg" is mostly windy pollinated or self-pollinated. The ripen fruit is bright, black-purple, round, sized from 4.0 to 5.5 mm in diameter. The inflorescence is pendulous, compact, and relatively dense. The fruits usually stay on the stem when ripen and finally take a dark burgundy colour. The pulp is juicy, dark red. Ripening of fruits usually starts in the second half of September and lasts quite a long time on the tree.

Anthocyanins (also anthocyans; from Greek: ἀνθός (anthos) = flower + κυανός (kyanos) = blue) are heteroglycosides composed of a sugar and an anthocyanidin. They are the most important components in elderberry fruit. The anthocyanins have significant antioxidant activity. The major five anthocyanidins in elderberry are cyanidin-3-sambubioside-5-glucoside, cyanidin-3,5 diglucoside, cyanidin-3-sambubioside, cyanidin-3-glucoside, and cyanidin-3-rutinoside (Salamon et al. 2021). The flowers, but mostly the ripen fruits of elderberry, are widely used in food, cosmetic, and pharmaceutical industries as well as in the phytomedicine.

The amount of the accumulated anthocyanin as the fruit pigments highly depends on suitable environmental conditions, especially temperature, solar radiation, as well as cultivation and production management. Wu et al. (2004) found that total content of anthocyanins in elderberry fruit varied from 602 to 1265 mg 100 g^{-1}. The most cultivated cultivar: "Haschberg" accumulated about 737 mg of total anthocyanins per 100 g of fresh weight. They also found the presence of all five the most important anthocyanins: cyanidin-3-sambubioside-5-glucoside, cyanidin-3,5-diglucoside, cyanidin-3-sambubioside, cyanidin-3-glucoside, and cyanidin-3-rutinoside. Other minor anthocyanins were found only in trace quantities.

26.6.1 Lyophilization Technology for Anthocyanin Isolation

Distillation methods are often used (hydro-, steam- distillations, or water vapour) to extract natural compounds (secondary metabolites of plants, animals, and other organisms). They can extract volatile oils and solids to produce liquid and dry extracts. In both methods, among different types of solvents and various temperatures are used. This directly affects the stability and frequently the breakdown of some sensitive natural components. Based on this fact, lyophilization is suitable for isolating natural substances.

Lyophilization (freeze drying) is done using a simple principle of physics called sublimation. Sublimation is the transition of a substance from the solid to the vapour state, without first passing through an intermediate liquid phase. This technology is important in pharmaceutical, food, and cosmetic industries (Genovese 2015).

Because anthocyanins are unstable in different pH and degrade rapidly at higher temperature and lights, therefore the freeze-drying process was used for their stabilization. The optimal extraction method and the process of freeze drying were developed to obtain pure anthocyanins from elderberry fruits (*S. nigra* L.).

Before a successful lyophilization, it was necessary to dilute extracts with purified deionized water in quality that complies the European Pharmacopoeia (Aqua purificata PhEur). The ratio of 4.7:1 was optimal for an extract from the elderberry (Salamon et al. 2021).

A variety of lyophilization procedures were tested and optimized so that the resulting product is a good, dry powder. Finally, for lyophilization, a program for 36 h was used, where the temperature of freezing was lowered to −40 °C. The program was separated into eleven sections where the temperature and pressure changed. This program included four steps—loading, freezing, evacuating, and drying (Tomash et al. 2015).

The pharmaceutical company Medicproduct, Co. in Lipany (Slovakia) uses freeze drying to increase the shelf life of products, such as vaccines and other injectables. By removing the water from the material and sealing the material in a vial, the material can be easily stored, shipped, and later reconstituted to its original form for injection. Our new original research deals with optimize extraction and freeze-drying procedures to the natural components. The purpose is carrying out a dry, quality lyophilized product, which is then submitted to further analytical and biological testing.

26.6.2 Anthocyanin Lyophilizates Enhance Growth and Inhibit Apoptosis in Rat L6 Muscle Cells

Anthocyanins are water-soluble vacuolar pigments that may appear red, purple, or blue depending on the pH of the solution. These natural components occur in all tissues of some higher plants, including leaves, stems, roots, flowers, and fruits.

The characteristic dark purple-red colour of elderberry comes from anthocyanins, water-soluble polyphenolic belonging to the flavonoid family. In addition to this, medicinal plant species have been used in traditional medicine for centuries in North America, Europe, Asia, and North Africa. Elderberry has antioxidant activity, lowers cholesterol, improves vision, boosts the immune system, improves heart health, and has good activity in clinical trials for coughs, colds, flu, bacterial and viral infections, and tonsillitis (Fejer et al. 2015).

Anthocyanins are known for their antioxidant, anticancer, and anti-inflammatory activities and have been suggested to be beneficial in maintaining and building bone and muscle in clinical trials (Yarahmadi et al. 2014); however, their mechanism of action is not well understood.

It has been demonstrated that elderberry anthocyanin lyophilisate protects rat muscle cells (L6 cells) growth in vitro. The extract also prevented cell death and apoptosis. The extract also prevented cell death and apoptosis. Of the anthocyanins present in the extracts, cyanidin-3-glucoside was the most active and enhanced L6 growth by 200%. These data suggest that fruit extracts reduce muscle cell apoptosis and may be useful for development as a preventative treatment for sarcopenia (Wicks et al. 2018).

Sarcopenia is an age-related condition and causes loss in muscle mass and function in the elderly, causing serious morbidity and mortality. Old age and muscular dystrophy are associated with an increased rate of apoptosis in skeletal myocytes (Wicks et al. 2018).

In terms of a mechanism of action, gene expression analysis showed that BCE treatment of the myoblasts produced a dramatic increase BCL-2 mRNA expression >284 fold over controls, reduced Bax mRNA expression, and also increased expression of PPARγ mRNA. Both BCE and C3G altered the Bax/Bcl-2 ratio in favour of reduced apoptosis and increased SS-cell proliferation. Besides, BCE enhanced Sirtuin 1 mRNA twofold. SIRT1 is known as NAD-dependent deacetylase sirtuin-1, a protein encoded by the SIRT1 gene. Activation of SIRT1 has been shown to improve metabolism and induces protection against physiological and cognitive disturbances in old age (Mitchell et al. 2014). These data suggest that fruit extracts and anthocyanins reduce muscle cell apoptosis and may be useful for development as a preventative treatment for sarcopenia and for possible dietary treatment of Duchenne muscular dystrophy (DMD). In DMD, muscle apoptosis precedes necrosis, and markers of apoptosis such as a reduced Bcl-2 mRNA expression are seen as an indicator of muscle degeneration (Abdel-Salam et al. 2009).

Elderberry and their active components have been traditionally used for treating influenza and colds in western and eastern countries of Europe. The highly active flavonoids extracted from elderberry inhibit influenza A (virus H1N1 infection) comparable to the anti-influenza drug of Oseltamivir (the neuraminidase inhibitor). Flavonoid of elderberry extracts blocks viral entry by binding to H1N1 virions and inhibits several strains of the influenza virus in vitro. (Zakay-Rones et al. 1995).

Viral neuraminidase (NA) is found on influenza virus surfaces and enables viral release from host cells. The cyanidin-3-sambubioside extracted from elderberry fruits

is also a natural NA inhibitor (Swaminthan et al. 2013). The compound cyanidin-3sambubiocide, an anthocyanin flavonoid, displays potent NA inhibition. The extract displays inhibitory potential on the H5N1-type influenza A virus (avian influenza).

The elderberry natural components have the potential to be used as antiviral drugs, include novel virus SARS CoV-2 (against the pandemic COVID-19) because they block the function of viral neuraminidases of influenza virus, by preventing its reproduction by budding from the host cell.

26.7 Energy Production from Renewable Sources

Nature, and especially the Sun, is the richest source of energy. Increased attention is paid to renewable energy in the agrarian policy of developed countries. In line with the European trends, 12–15% of national energy consumption shall be covered by these sources, and the rural areas represent the ideal environment for their production (Petříková et al. 2006).

26.7.1 Biomass and Production of Energetic Crops

The term biomass includes various natural products as an outcome from the plant's photosynthesis process. Photosynthesis of green plants can capture 1–3% of the incident solar energy. When looking for new energy sources, the attention naturally focuses on biomass as a reliable and constantly renewing energy source. Biomass has the greatest potential for further development among all renewable forms of energy (Petříková et al. 2006). The main reason is that in many areas with a shortage of natural deposits of oil and coal it can replace these conventional fuels.

Main methods of production of plant biomass are as follows:

- cultivation of energetic crops for solid biomass production,
- growing of oilseeds for the industrial production of biofuels,
- using wood waste from wood processing factories and forests for energy production.

It is clear from the above-mentioned points that the crops in question are gradually transformed into cultivated crops important in connection with sustainable farming systems, the use of new resources, and the diversification of the rural economy in the Medzibodrožie region (Dobos and Novák 2008).

The production of energetic crops can also partially provide an aspect to the solution to the insistent socio-economic problems of the Gypsy population. Support for solutions and its results may soon reflect in the elaboration of the principles for rational settlement building for this ethnic group that will be without undesirable logging in protected areas.

For energetic purposes, we can use a large number of different plant species characterized by rapid growth and quality of produced biomass. Energetic crops can be divided into one-year plants, multiannual, and perennial non-woody energetic crops and trees (Porvaz 2005). These plants include oilseed rape, cereals, sunflower, corn, sugar beet, potatoes, cannabis, sorghum, common flax, poppy, and others. Multiannual and perennial energetic crops include Chinese silver grass, knotweed, phragmites, Jerusalem artichoke, sugar cane, burclover, reed canary grass, hollyhock, and others. For the establishment of fast-growing tree plantations, the best suitable plants are eucalypts, plane trees, aspen, locusts, willow, alder, and others, which are also suitable for the use at waterlogged areas that are very numerous in the Medzibodrozie area.

Energetic crop Chinese silver grass has been introduced in eastern Slovakia during the last few years. The yield potential of Chinese silver grass (*Miscanthus sinensis*) exceeds the potential of domestic species grown in our country, including fast-growing trees. The plant can be considered a significant source of raw construction materials, for industrial and energetic use. The study of the influence of factors of harvest, trimming, fertilization, and mechanical and morphological properties of plants has been examined by several authors (Porvaz 2005; Petříkova et al. 2006; Clifton-Brown and Lewandovski 2002; Kaack and Schwarz 2001). On well-stocked soil, the plant is well grown without fertilization in the first year of cultivation and does not go into further production. Harvested material is used as a mulch against damages caused by freezing. The production is collected only from the second year of cultivation. The harvest achieved in the cultivated fluvisol conditions is 30–34 t ha^{-1}.

26.8 Rural Tourism and Agritourism

Rural tourism represents a relatively new form of tourism in Slovakia. It means the realization of tourism in the countryside, excluding recreational activities that are connected to a rural environment and different from civilization's recreational activities (Otepka and Haban 2007). Its specificity consists of decentralization of accommodation facilities, which allows dispersal of tourists and thus to eliminate the negative impacts of a high concentration of people in tourist centres. It allows individual activities in the phase of offering the product and its implementation.

The concept of implementation of rural tourism activities means a return to nature in some way and return to the traditions and activities that directly reflect the ways of securing basic life needs (Dobos and Novak 2008). It is a special form of recreation in a rural environment, taking advantage of the variety of services that this environment provides (meadows, forests, ponds, rivers, local crafts, folklore, etc.). Those interested in rural recreation will be provided by services by making use of the free capacities of rural houses, business, accommodation, catering, sports and leisure facilities, and the countryside environment. Generally, it appropriately complements agricultural production, by providing agricultural products, recreational facilities of tenants, and free capacity of the facilities services, to holidaymakers. The quality of

rural tourism can be summarized in the following keywords: silence, greenery, the environment, relaxation, return to traditions, and contact with the local population, etc.

Agritourism is a business activity that is provided by the operator (multifunctional agricultural company, joint-stock Company, Ltd. Company, farmer, town, and region) to the tourists for relaxation in a rural environment. It includes specific activities of agribusinesses and farms according to local economic and natural conditions, focused on meeting the recreational needs of tourists.

It is a specific form of rural tourism which, in addition to the direct use of nature and the rural environment, is also characterized by a direct relationship to agricultural activities or to the objects with agricultural functions (Salamon 1998).

Regarding the type and the number of services provided, we can identify the following main types of agritourism with concretization of their use in the area of Medzibodrožie (Takač and Szilasi 2008):

- holidays at the farmer's yard (the use of mainly older yeoman houses)—the tenant, besides the accommodation, also provides other services to satisfy the customer's requirements (equine-assisted therapy, herbalism, aromatherapy, massages, etc.), to generate side income;
- gastronomy agritourism—in its foreground, there is a direct sale of regional specialties (mush "pencári", pancakes "lokše", goulash, red pepper stew, soup "halászlé" and "juchu", home butchers pork menu, wine tasting, etc.) to their guests, a regular circle of customers or restaurants with cymbal music and dancers of the Čardáš dance in pairs, queues, circles, or "solo-Hungarian" Čardáš dance, as a Verbunk dance;
- agritourism with the rental of holiday houses (farmer's, yeoman's or brick-built multipurpose houses with pillar facades) with a focus on fishing, hunting, mushroom picking, wine houses with vineyards, and wine cellars with or without provision of services;
- eco-agritourism, provided by eco-farms producing bio-products without the use of mineral fertilizers, pesticides, and heavy mechanization;
- ecotourism with an emphasis on nature wandering (walking, cycling, sailing, horseback riding, etc.) with an emphasis on observation and exploration, especially invaluable natural areas with extraordinary landscape scenery (a large number of protected areas of the Medzibodrozie), cultural (presentation of folklore traditions during holidays throughout the year: vineyard harvesting, harvest festival, construction of May trees with May festivals, local markets, etc.), and historical (the manor in Somotor, Streda nad Bodrogom, Leles, part of the Tokaj wine route, etc.).

The primary importance of agritourism for agricultural subjects is the acquired source of farms or enterprise income, which provides certainty for existence. It significantly finalizes the production of business entities by making it possible to monetize their products, accommodation capacities, even the technological process and the environment of the farm (farmyard), the fields, the meadows, and the landscape. It creates suitable conditions for the production of less fertile soils or even

endangered agricultural companies and farms. In the end, providing of agritourism services requires a certain degree of equipment of agricultural settlement and thus increases the overall standard of households in these often-remote areas, etc.

Agritourism has its importance also for the villages and towns (Otepka and Haban 2007). At most, it makes use of existing objects that ceased to serve their original purpose. It increases the level of equipment of the municipality (as a prerequisite for the development of rural tourism and agritourism) and creates additional sales of agricultural products as a stimulus for the expansion of production. It increases the income of the inhabitants of the village, the village itself, which can be reflected in its facilities. It creates the appropriate conditions for creating new job opportunities, revives, and maintains craftsmanship, folklore, and other traditions. It contributes to the utilization of the natural, cultural, and historical potential of the village and preserves its original landscape character.

26.8.1 Tokay Wine Region

The special climatic and environmental conditions of the Tokaj Region, also shaped by human activity exploiting these, gave way to a unique tradition of viticulture and wine-making (enology).

Tokaj wine region is a geographically closed area in the basin of the Bodrog river, north Slovakia Zemplín bordered to the south, and Hungary bordered by the confluence of the Tisza and Bodrog. Slovakia is delimited by law 907 ha. It is the smallest wine region in Slovakia (Pospišilová et al. 2005).

The volcanic slopes and wetlands create a special microclimate that favours the apparition of the "noble rot" (*Botrytis cinerea*). The landscape is characterized by a rich variety of building structures (terraces, supporting walls, dry-built stone fences, water cisterns, etc.). Thanks to the unique microclimate, cellar walls are colonized by a special cellar mould called *Gladosporium cellare*, which has a benign influence on the maturation of wines. Sessile oak growing in the higher ranges of nearby mountains provides an excellent raw material for wine barrels, which is a decisive factor for the maturing process, aroma, and colour of the wine.

The diverse socio-economic, cultural, ethnic, and religious background of the population of Tokay Region and last, but not least, the outstanding fame of Tokay wines have contributed to the establishment of the rich and varied cultural heritage of the region.

Typical names Tokay wines (Hronský 2016):

- Samorodné—if the wine is produced by ethanol fermentation from Tokay grape varieties, grown on special selected tassels if there are favourable conditions for mass creation of raisins are two types of autogenous wines: dry—grapes must have a sugar content of at least 21 °NM and made wine must have content natural sweetening and 10 g l^{-1}, and sweet—grapes must have a sugar content of at least

24 °NM and the wine produced shall have a natural content of residual sugar above 10 g l^{-1}.

- Selection—the wine to the ethanol fermentation after pouring the raisins harvested skilled special selected tassels must with a sugar content of at least 21 °NM. Depending on the quantity, added raisins are divided into 3–6 Tubes (Putnam—formerly wood, now and plastic container, which is used for carrying grapes, usually has a capacity of 20–60 l. The Tokaj region, this vessel with a capacity of 15 l is also used as a measure of the processing raisins).
- Mášláš—wine produced by ethanol fermentation of must or wine of the same vintage from qualified furlongs, poured on fermentation lees of wine Samorodné or Výber. It is marketed after two years of maturing, of which at least one year in a wooden cask.
- Forditáš—wine produced by ethanol fermentation of must or wine of the same vintage from qualified furlongs, poured on wine marc of raisins harvested for qualified hunts. It is marketed after two years of maturing, of which at least one year in a wooden cask.
- Selection Essence—wine obtained by ethanol fermentation of raisins qualified furlongs. At harvest, the grapes specially selected to be drenched immediately after the processing of the must from the defined vineyard, which contains at least 180 g l^{-1} of natural sugar and 45 g l^{-1} of sugar-free extract. It is marketed after three years of maturing, of which at least two years in cask.
- Essence—wine produced by slow fermentation samotok, which is obtained from separately collected raisins harvested for qualified hunts. The essence shall contain at least 450 g l^{-1} of natural sugar and 50 g l^{-1} of sugar-free extract. Wine has been marketed after three years of maturing, of which at least two years in cask.

26.9 Territory Care

The state of the Medzibodrozie region is getting worse. Intensified anthropological activities (production or civil), depopulation of rural areas, lack of protection, and climate changes in recent years due to polluting emissions are causing dramatic weather changes that often lead to natural catastrophes. The main cause is progressive soil erosion and inadequate control over surface waters (Terek and Maťaš 1983).

Territory care and risk prevention require detailed planning and broader interventions at the level of local government, management of multifunctional agricultural companies, and other business entities. Therefore, it is necessary to cooperate in the implementation of strengthening of slopes using engineering works to control erosion—cleaning of banks and river beds in the framework of flood prevention—optimization of surface water regime—alarm network and flood emergency system (Midriak et al. 2008).

26.10 Conclusions

In conclusion, it is important to emphasize that the new Common Agricultural Policy recognizes the essential role of agriculture in environmental protection and focuses its support in this sector towards the creation of an agricultural model based on environmental sustainability, food security, and territorial balance. Presented clauses point to the need for further development of the agro and food sector in this new trend, which already appears in the directives and strategies adopted by the European Union.

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