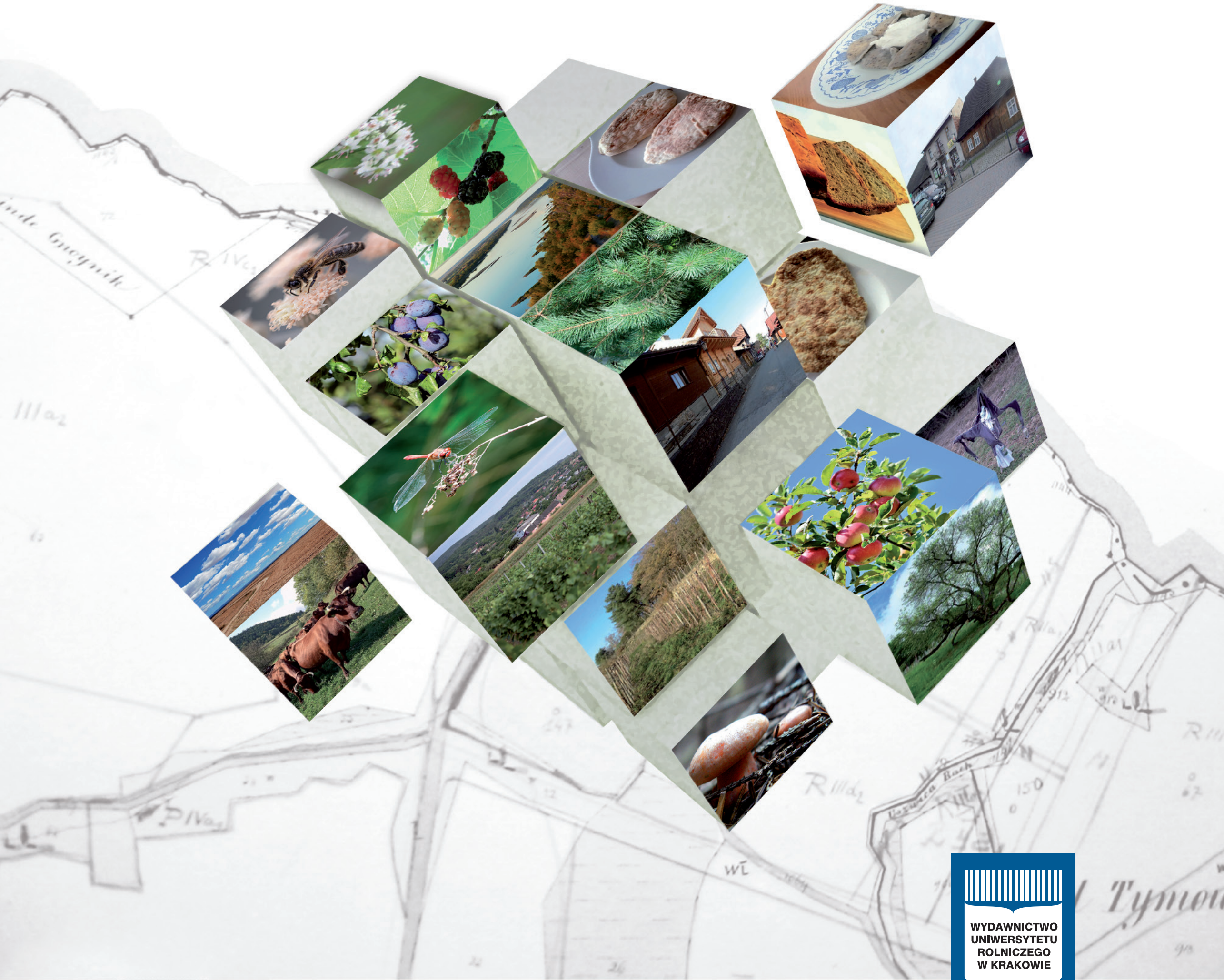
Indicators of change in cultural heritage

Monograph

Edited by
Józef Hernik • Karol Król • Barbara Prus • Maria Walczycka • Robert Kao



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Content

I

Cultural landscape

1

Identification of cultural heritage indicators. A case study of architecture in Lanckorona

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Abstract. Polish regions exhibit individual architectural features. That notwithstanding, they have been undergoing unification and destruction for years. The features need to be extracted to preserve the cultural continuity of specific areas.

The paper looks into the problem of the individuality of cultural heritage characteristics of the investigated area. An attempt was made to identify indicators in the village of Lanckorona, known for its specific architecture and ornaments. One-storey buildings feature jerkinhead roofs with extended eaves that make up a kind of overhang, drive-through entrance halls of front buildings with massive doors, or houses separated by narrow paths along boundaries. All these features are typical of the village. The distinctive wooden architecture, gathered around a rectangular market square, contrasts with multi-storey wooden residences. As the study includes a mediaeval castle overlooking the village, the palette of forms unique to Lanckorona appears substantial.

The study involved methods typical of architecture and landscape architecture. They involved *in-situ* research, including landscape architecture survey with an analysis of valuable cultural assets and an archive source material research. A cartographic and iconographic review of historical sources provided insight into objects that do not exist anymore but had indicator features that confirm their unique nature.

The work was aimed at preserving and presenting the indicators using Lanckorona with its particular cultural heritage qualities as an example so that the research procedure could be applied to other rural areas.

Keywords: cultural heritage • architecture • ornaments • village • rural areas

1.1. Introduction

The Polish rural landscape has been changing for the last several decades. The growing globalisation and transport have been transforming rural areas. The ingress of the urban lifestyle additionally affects the changes in the traditional countryside landscape. The countryside population who abandon agriculture and move to urban areas promotes this process. The political system (socialism) and lack of local zoning plans significantly affected transformations in the Polish urban and rural architecture deviating from traditional norms. The political transformation of the 1990s brought more changes due to the cancellation of the existing plans, which contributed to the chaos in urban structures. Over the decades, traditional architecture came to be perceived as a synonym of parochialism.

As the tradition is vanishing, it is essential to investigate the unique features characteristic of selected villages. If they are identified and described in detail, the authenticity of form can be preserved [Mitkowska 2007], and they can be employed by residents as original details defining the identity of the location.

The paper reports an analysis carried out in Lanckorona, a village in southern Poland, Małopolska region. The authors focused on recording features characteristic of the village that were not lost despite architectural, social, economic, and spatial changes. They are indicators or flags denoting the uniqueness and recognisability of the place. Particular emphasis was placed on indicators related to wooden architecture in the area.

1.2. Investigated area

The research was conducted in the Małopolska region, in southern Poland. The region offers diverse landscape zones comprising the Silesia-Kraków Upland, Małopolska Upland, so-called Northern Subcarpathia, and a range of the Carpathian Mountains. In general, 58% of the natural environment in the area is protected [Böhm 2006]. The region has an abundance of cultural buildings and complexes of supralocal importance. Four of them have been listed by UNESCO, including Kalwaria Zebrzydowska: the Mannerist Architectural and Park Landscape Complex and Pilgrimage Park neighbouring on the investigated village.

The focal point of the paper is the area of the village of Lanckorona (town privileges until 1934, today a municipality administration centre), the Wadowice District, Małopolska Region, about 40 km from Kraków. Its specific town-like urban arrangement stems from mediaeval settlement structures. Its historical wooden architecture is clustered in the centre and exhibits specific features of the 'Lanckorona style'. The urban arrangement and buildings are one of the sights on the Małopolska Wooden Architecture Route.

1.3. Objective

The objective of the research is to identify, delineate and describe cultural heritage indicators in Lanckorona with particular focus on characteristic features of the local wooden architecture. The authors characterised the buildings in the village in general. Unique components related to the structure of walls, roofs, and window joinery were described in detail and illustrated.

The landscape transformations in the village were analysed in the context of changes in the spatial structure. The authors determined historical compositional phases for the place. Another important point was to consider visual connections important for the general experience of the landscape complex of Lanckorona and the UNESCO buffer zone around Kalwaria Zebrzydowska.

1.4. Research methods

The work employs three research methods, important architectural tools. The first one is observation. It is counted among the oldest methods where information and facts are recorded, collected, and juxtaposed [Apanowicz 2002]. The first stage involved a general preliminary investigation of the surroundings of Kalwaria Zebrzydowska. The area was selected because of the large number of traditional villages as identified in the literature on its history and current situation [Siemionow 1984, Zinkow 2000, Mitkowska 2003]. Next, the data were interpreted as to narrow down the research problem. Preliminary research involved a review of examples of urban arrangements in Małopolska to select the right urban structure with the qualities of interest (indicators) and unique features.

The next employed method was a case study, which looks into specific individual events, persons, and in this case – objects [Poskrobko 2012]. The urban arrangement and landscape context of the analysed village of Lanckorona with some features of a mediaeval town were investigated in general terms, while indicators of its unique nature related to wooden architecture were considered carefully. The authors used expert literature at this second stage, such as Bogusz [1988], Czerwiński [2006].

The *in-situ* method was employed simultaneously, which involves site visits, photographs, drawings, and comparison of material with the current situation.

1.5. Environmental and geographic conditions in the region

The municipality of Lanckorona is situated at the interface of Wieliczka Foothills, Maków Beskids, Silesian Nappe, and Magura Nappe in Carpathian flysch [Lanckorona 2002]. The topography consists mostly of foothills. The municipality of Lanckorona is situated in a transitional belt between mountains and foothill valleys. Its lowest point is in Podchybie, while the highest location is the Lanckorona Mountain. In terms of administrative subdivision, Lanckorona is located in the Małopolska Region, Wadowice District and borders on the following municipalities: Kalwaria Zebrzydowska, Skawina, Budzów, Sułkowice, and Stryszów.

From the geobotanical perspective, Lanckorona features transitional qualities between Wieliczka Foothills vegetation and mountainous flora of the Beskids. The area has two attitudinal zones: foothills and the lower subalpine forest with Carpathian *Fagion sylvaticae* and mixed spruce-fir-larch coniferous forest with the natural historical stand of the Polish larch.

On the northern slopes of the Lanckorona Mountain, there are valuable stretches of mountainous riparian forests (Carpathian *Alnetum incanae*) and marshland vegetation with abundant stands of great horsetail. Mountain streams intersect the mountainous areas. The region is home to many protected animal species such as the fire salamander or Carpathian newt.

Another quality of the place is the diversified Carpathian landscape emerging from a vivid natural and cultural mix: Alternating undulating and gentle hills with chequered agricultural fields, meadows, and large forest complexes dotted with Calvary shrines, or such dominant features as the ruins of the Lanckorona castle and the church.

All these natural and geographical components add the natural dimension to the rich cultural landscape of Lanckorona, making it unique at a regional scale.

1.6. Abridged timeline of Lanckorona

Processes involved in the emergence of this group of localities in Central Europe have divergent components related mostly to parallel civilizational, social, economic, and artistic transformations [Eysymontt 2009]. Most European urban settlements date back to the twelfth or fourteenth century and were usually established on existing settlements. Their characteristic features included chessboard arrangement of streets, regular blocks of built-up areas, and rectangular main square layout. The dominant feature was usually a church, castle, or town hall [Adamska 2013]. Lanckorona dates back to the twelfth century when a fortified town was located at the top of the Lanckorona Mountain. Its role was to guard nearby trade routes to Hungary, Bohemia, and Silesia [*Zabytki urbanistyki i architektury w Polsce* 1986] In the effort to improve the defensive potential of many strategic locations in Poland, King Casimir III the Great built a castle at the top of the Castle Mountain in the first half of the fourteenth century. It was the administrative centre for the Lanckorona Starosty, which covered Lanckorona and 16 nearby villages. German settlers established this settlement outside town walls, and some sources refer to it as *villa Hermani*. It was a rural settlement with a church and then evolved into a town [Grodnicki 1995, Pacuła 2007, *Zabytki urbanistyki i architektury w Polsce* 1986]. Its probable layout was enclosed in fusiform boundaries with the church in the west. Royal privileges of 1361 and 1366 opened the way for the establishment of a town with Magdeburg rights and the privilege of a weekly marketplace, cloth and other material trade in Kraków, and the right to fell trees downstream of the locality for construction purposes [*Słownik historyczno-geograficzny* 2010–2019]. The outline evident today was based on a 90 by 100-metre rectangle. Each side had four blocks of developed land; shorter ones had eight plots each and longer sides had eleven. In general, the dominant arrangement was 'windmill' or 'turbine' enclosed in earth ramparts. The place developed eastwards and included a cemetery. The outskirts were called 'Świętokrzyskie' or 'Jastrzębii'. At the end of the sixteenth century, the owner of the land was Mikołaj Zebrzydowski. It was on his initiative that the mannerist Calvary was created, also known as the Polish Jerusalem. The idea behind the place was to commemorate the Passion of the Christ in the picturesque landscape of mountains: Żarek and Lanckorońska (Castle Mountain).

Lanckorona grew dynamically until the second half of the seventeenth century when it fell into regress due to the war. Until then, agriculture, trade, and craftsmanship thrived. According to vetting data from 1564, the Starosty (*Capitaneatus Lanckoronem*) included 23 villages. The growth of the town was limited because of a long distance to trade routes. Fires ravaged wooden architecture of the town and significantly reduced the population (for example in 1717 and 1869). The town did not manage to restore its previous condition and lost its charter in 1934. Today, the preserved mediaeval urban arrangement based on a fourteenth-century planning composition is worthy of attention.

1.7. Regional links

An important aspect, which affects the qualities of Lanckorona is its visual connection with other cultural (mostly sacral) and natural dominant features. The visual qualities of the place were validated by Stanisław Witkiewicz (a Polish artist, painter, architect, and writer) who described his experience on his railway trip to Zakopane in 1885. *Near Kalwaria Zebrzydowska, the rails become so twisted, the ride is but a reminiscence of a bizarre and impossible dream. The monastery, a multitude of chapels, shrines, and small churches dance around. The ruins of the Lanckorona castle bulge out of the black forest like a decaying tooth, and together with the hill bars the way, flees from right to left, falls behind only to dart back in the front* [Siemionow 1984]. The visual qualities of Lanckorona are emphasised in the 1914 guide *Przewodnik po Galicyi* [Orłowicz 1914]. The author praises the view towards Babia Góra, the Tatras, and Kraków, which the castle ruins offer. Current research on the selected area of the Wadowicki District with digital terrain model confirmed significant view relationships between the landmarks of Lanckorona (the castle and church) and other dominant features located much further, such as the monastery in Kalwaria Zebrzydowska [Prus et al. 2020].

1.8. Urban structure profile and its evolution

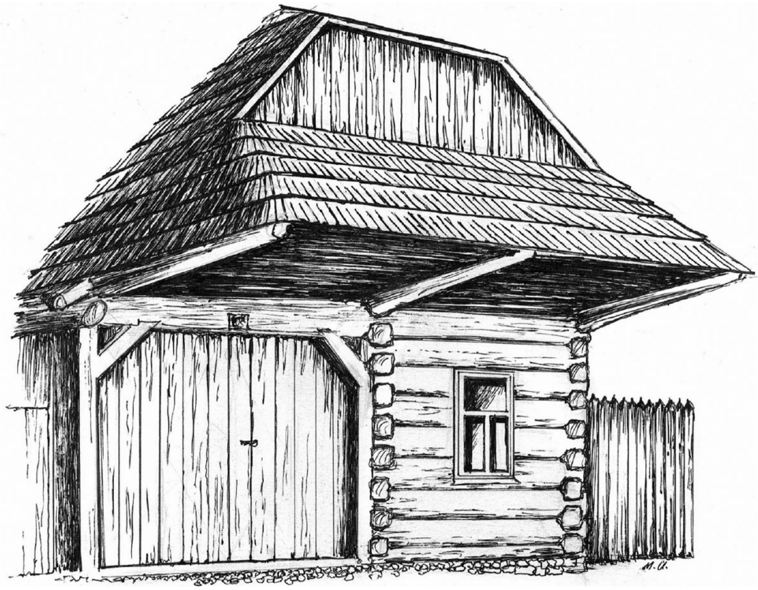
The growth of chartered towns depended mainly on the distance to trade routes, natural resources available, and the well-being of craftsmanship. The peripheral situation of Lanckorona contributed to its conservative growth, while consecutive fires pushed it towards decline. The mediaeval contour of the town is apparent even today despite the reconstruction effort after 1869. Therefore, the original architectural tissue was not saved, but the scale and form of wooden buildings remain traditional [Chrzanowski and Kornecki 1982]. The spatial arrangement of Lanckorona is characteristic of places with impeded development. Sources do not offer a mention of an official town hall. A masonry building in the northern frontage was its functional replacement. No orders were recorded to have been invited to the town, which would be indicative of its wealth. The parish church located further to the north from the market square was rebuilt in the sixteenth century. Documents mention earthworks around the town. The structure was at first important for cultural and political reasons, but its defensive value diminished in time. The castle towers over the entire area. It is part of the Vistula zone and Kraków and Wieluń Upland defense system [Grodnicki 1995]. The landscape holds relics of the fortress in the form of a conical keep, a bastion from the time of Bar Confederation in the eighteenth century and the so-called great bastion built by the Austrians during the partitions. The castle was captured many times, which had poor consequences for the town at its foot, and directly affected its condition and growth. During over a century of partitions, initially the Austrians used the castle as their barracks and prison. In the period between its abandonment and the mid-nineteenth century, it was completely devastated and partially demolished as a source of construction materials also for the Holy Cross church situated on the cemetery. The slump was related to the lack of railway or road links to the outside world. The urban structure transformations in Lanckorona can be categorised into five phases. The first one is related to the settlement outside of town walls from the twelfth to the fourteenth century. The fusiform structure grew steadily. The next phase, from the fourteenth to the seventeenth century, was decisive for the shape of the place. The town was established with Magdeburg rights. Hence the rectangular plan of the market square preserved today. The third phase, stagnation, lasted from the seventeenth century to 1869 when a great fire significantly damaged the buildings. The fourth phase was a slow development, initially focusing on reconstruction. After 1919, this was driven by the effort of the Committee for Establishing a Summer Holiday Site and Care Centre for Wartime Orphans. It promoted Lanckorona, making it a famous summer holiday destination for residents of Kraków since the early 1920s. New guesthouses, residences, and sports facilities were built at the time [Pacuła 2007]. The fifth phase was the post-war period of neglect and push towards the socialist 'modern', based on structures deprived of their historical context and style, damaging the architectural arrangement, until the 1990s when the market square was restored. More generally, note that the investigated locality is situated in the UNESCO buffer zone of the Kalwaria Zebrzydowska: the Mannerist Architectural and Park Landscape Complex and Pilgrimage Park.

1.9. Indicators of historical architecture in Lanckorona

The market square is the central point of the village. As it is the focal point around which historical buildings are situated, there are many indicators of the uniqueness of the place here.

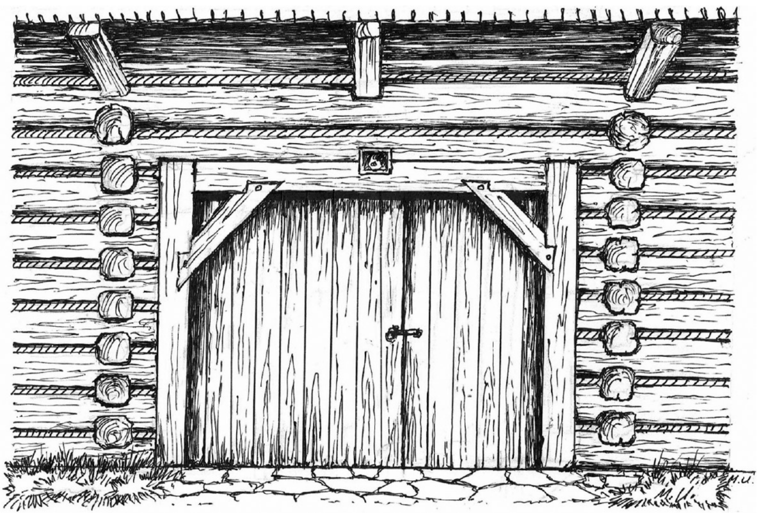
The market square is located on a slope and overlooked by a masonry parish church of the Nativity of John the Baptist founded by a Polish King Casimir III the Great. It is the most typical public space in Lanckorona. Its northern frontage hosts the former seat of the town council, a one-storey, masonry building from the nineteenth century. Higher, on the top of the hill, there are the castle ruins. A house in the lower, southern frontage has a Museum Room. It is one of a few wooden houses with a wood shingle roof not destroyed by the 1869 fire.

The traditional buildings in Lanckorona as classified as a group of Kraków vernacular architecture. A characteristic feature of houses in Lanckorona is first and foremost the vastly extended eaves of jerkinhead roofs (Fig. 1.1). What is interesting about the eaves is that they no pillars support them. This arrangement provides ample space that is protected against elements, below the eaves.



Drawing: M. Uruszczak

Fig. 1.1. Vastly extended eaves overhanging the face of the front wall are the typical feature of the Lanckorona architecture

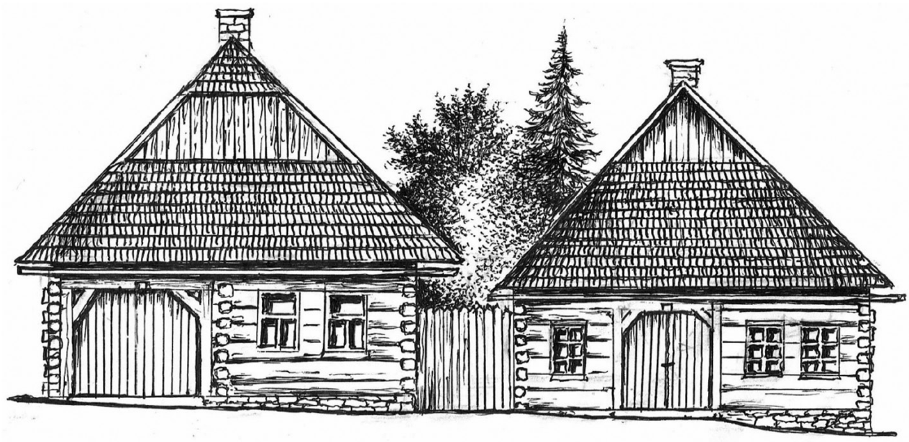


Drawing: M. Uruszczak

Fig. 1.2. A typical door in a Lanckorona-style house for driving carts through to the backyard of the household

Another distinctive feature of the Lanckorona regional building form is large doors (Fig. 1.2) that lead through the entrance hall to a small, private farmyard at the back of the house, inaccessible from the outside.

In the centre of Lanckorona, houses around the market square are front-gabled, situated with the short side and gable facing the market square. This results in narrow spaces between buildings called *miedzuchy* (Fig. 1.3) (from the Polish word *miedza* for baulk). There are also many buildings with the long side facing the market square. These are mostly more recent structures, typically built immediately before or after the Second World War.



Drawing: M. Uruszczak

Fig. 1.3. As the houses were front-gabled and rainwater had to be evacuated somehow, the buildings are set at a distance to one another. The narrow spaces between them are called *miedzuchy*

The primary construction material in Lanckorona was fir timber. Oak timber was also sometimes used, especially for sill plates that are the lowest wall beams. These beams were usually thicker than the other ones. They were set on wall bases or foundations, which levelled the terrain. Sometimes the wall base was so high that it was used as a cellar, mostly with a barrel vault [Czerwiński 2006].

Doors and windows significantly affect building appearance. The architecture of Lanckorona rural houses most often had doors made of vertical planks. Decoratively boarded doors were slightly less popular. They were set in a vertical door-frame, connected with a horizontal beam, usually decorated. Its lower part was sometimes notched to form a semi-circular surface. The beam could also feature special angle braces called *zwieracze*. The door was mounted on a rudimentary wooden hinge system (*biegun*) or iron hinges produced by a blacksmith.

The most popular wall design was the log structure. It can use various types of corner joints called: *na obłap* (double saddle), *na nakładkę prostą* (square notch), *w jaskółczy ogon* (dovetail), or *na zamek* (interlocking joint) [Bogusz 1988]. Put simply, log structure involves logs with appropriate notches being set on one another at the right angle in corners and pressed from above. Gaps between logs were insulated with grass shoots, straw, or sometimes clay [Fryś et al. 1988].

The roofs exhibit a characteristic style that can be found in many places in Poland. Roofs in Lanckorona are mostly gable roofs, often jerkinhead roofs with very extended eaves (a feature that is unique in Poland), which give them an uncommon appearance. Not every house in Lanckorona is like that. Most buildings have roofs described as a 'jerkinhead roof with a partial roof connecting eaves on long sides' (*daszek przyzbowy* resembling Dutch gable roof), or a 'gable roof with a partial roof connecting eaves of long sides, southern Poland type'. Gable walls are covered in vertical planks, usually with small openings for ventilation and smoke evacuation (*dymnik*) just below the ridge. Guesthouses have gable roofs or sometimes jerkinhead roofs. They have protruding triangular dormer windows (*jaskółka*) set vertically into the roof with a window or a balcony below a double-sloped roof. The traditional roofing consists of wood shingles, but many buildings are covered in ceramic tiles, concrete tiles, or steel roofing tiles.

Lanckorona residences built in the Zakopane style were constructed in the 1920s and 1930s as tourism facilities. The most famous ones were named: 'Modrzewiówka', 'Willa Róż', 'Gąsiorówka', 'Tadeusz', 'Zbyszek', 'Wrzos', 'Widok', 'Bajka', and several more. They were located on Zamkowa Street, św. Jana Street, Podzamcze Street, Legionistów Street, and Krakowska Street [Krzemień 1991].

1.10. Discussion

The problems with the preservation of rural developments were discussed by Chrzanowski [1978] and Kornecki [1982], among other authors. They proposed an interdisciplinary approach to the investigation of rural development arrangements and individual buildings, with the view to preserving and restoring them. In Lanckorona, attempts to restore the place (the 'Lanckorona experiment') were made after the Second World War. The plan was to turn Lanckorona into a tourism destination. Regrettably, the monument conservation authorities at the time imposed severe restrictions forbidding building repairs by house owners themselves, which brought many monumental residential buildings to ruin. Later restoration activities were related to the revival of the market square in Lanckorona. The time was favourable when the Kalwaria Zebrzydowska complex near Lanckorona was listed as a UNESCO heritage site. Residents and authorities hoped for the revival of tourism to strengthen the place and shake off the stagnation. The effort to recover the market square yielded fruit. Appropriate design solutions emphasised the integrity of the place with the local landscape and created the feel of a nineteenth-century town. The project inspired people living near the market square to continue the effort by drawing on the 'Lanckorona style' during repairs. Moreover, the entrance gardens they planted stressed the tradition of rural gardens by using local plant species (Fig. 1.4).

Photo: M. Wilkosz-Mamcarczyk

Fig. 1.4. An entrance garden in Lanckorona

a) b) c)

Photos: M. Wilkosz-Mamcarczyk

Fig. 1.5. The dissonance between historical buildings and structures from the 1970s (a); The development from 2014. The houses visibly deviate from traditional forms (b); A newly repaired building with traditional construction solutions (c)

Regrettably, there are still some buildings in the market square that deviate from the historical style (Fig. 1.5a). The cultural landscape standardisation progresses with each ready-made building design implementation bereft of style and detached from the rural context [Scheme 2011]. A particularly strong point was made near the centre in the form of a single-family development (Fig. 1.5b) build on a site damaged by landslides. On the positive side, some residents strive to keep to the regional traditions (Fig. 1.5c).

1.11. Conclusions

The results indicate the importance of indicators for determining the heritage of individual settlement structures. The uniqueness of the presented indicators stems from their historical and artistic value, but their special character is strengthened by the location of the whole locality within its landscape structure. The effort is reflected in UNESCO recommendations with guidelines for the protection of the beauty and character of the landscape and landscape sites [Paris 1962]. These indicators can be the starting point for the implementation of some schemes to revive the Polish countryside, such as Rural Renewal. The objectives of the scheme, which originated in Germany and was later disseminated throughout the EU, include protection of cultural values, mainly rural architecture, to preserve the architectural and building identity of the region [Uruszczak 2016]. Such attempts were made in the Opole Region through the participation in the European Association for Rural Development and Rural Renewal (ARGE) in St. Pölten since 2001 [Hodor and Klimek 2013]. Note that many locations in Europe contributed to the development of economically underdeveloped areas through revitalisation. Appropriate effort to expound the local tradition in cooperation with regional authorities and residents has led to growth. Landscape, culture, and environment are unique values. It is important for the preservation of tangible and intangible values to maintain individual features in the form of identified groups of indicators [Hodor and Klimek 2013].

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2

The scarecrow as a vanishing indicator of cultural heritage of rural areas

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Abstract. Scarecrows have always been present in the rural landscape. Not only could they have been seen in Poland but also throughout Europe and in many other countries worldwide. The erection of scarecrows in fields or home gardens used to be often practised in the countryside. The scarecrow was a product of culture inseparably linked with agriculture; They took on various forms, and were referred to in different ways. The political and economic transformations in Poland have affected the model of living and farming in the countryside, and have also brought about changes in the perception of cultural heritage of rural areas. Technological development and the pursuit of production efficiency have resulted in the scarecrow becoming a relic of the past and vanishing from the rural landscape. The traditional dummy made from straw has been replaced by electronic deterrent devices or chemical preparations. The scarecrow, which is cultural heritage for the older generations of Poles, is perceived by the current generation as merely a straw dummy with neither practical applications nor cultural significance.

Keywords: cultural changes • cultural heritage • heritage phenomenon • rural culture • folk rituals

2.1. Introduction

Rural areas are often considered equivalent with tradition, folk culture and the preservation of timeless values. In rural areas, there are many unique religious and secular buildings as well as farming methods and customs related to everyday life and celebrations [Puchnarewicz 2013, Prus et al. 2020].

Rural identity, as a significant component of the functioning of rural areas, can be preserved and strengthened as a result of measures aimed at the protection of cultural heritage. Cultural heritage of rural areas is comprised of the resources of material and immaterial culture which have become a component of culture passed on to subsequent generations along with traditions. Cultural heritage is a specific resource of local communities, regions, countries or, finally, the entire mankind. It is an important link of the identity, and a social integration factor.

In view of the dual nature (tangible and intangible) of cultural heritage, its protection requires various types of support [Kwiatkowski 2018]. It is important to materially secure the components that make up heritage, and to care for the preservation of cultural memory. as rich cultural and natural heritage provides opportunities for socio-economic development in rural areas [Hribar et al. 2015].

Until recently, scarecrows were a distinguishing feature of the rural landscape. A distinguishing feature of the rural landscape is an identifier used to describe rural resources e.g. in order to distinguish between particular localities. It is also a set of features, both tangible and intangible, which are a sort of a genetic code of a particular space. A distinguishing feature of the rural landscape is a tangible or intangible carrier of either characteristic features of the rural landscape or the ones based on the dissimilarity and/or contrast [Niedźwiecka-Filipiak 2016, Niedźwiecka-Filipiak et al. 2018].

The scarecrow has always been found in the rural landscape, not only in Poland but also throughout Europe and in many other countries worldwide. They have taken on various forms, and been referred to in different ways [Król et al. 2019]. The scarecrow is a product of culture inseparably linked with agriculture. However, technological development and the pursuit of production efficiency have resulted in the scarecrow becoming a relic of the past and vanishing from the rural landscape [Lorimer 2013]. The traditional dummy made from straw is being replaced by electronic deterrent devices or chemical preparations.

The aim of the study is to demonstrate the changes which have occurred over recent years in the way the scarecrow is perceived, and in its role in cultural heritage of rural areas in Poland.

2.2. Cultural heritage of rural areas

Cultural heritage is a multi-faceted and extremely complex term. According to Hewison [1987], *heritage can mean anything you want*. Classifying cultural heritage objects is sometimes difficult because the significance of each work for culture should be considered based on the criteria relevant to the cultural context to which it belongs.

Moreover, a shift from expert knowledge towards the involvement of the community (heritage recipients) and taking into account the cultural factor while selecting criteria for heritage assessment have provided a new horizon of thinking about this phenomenon.

Cultural heritage is an important factor of socio-economic development, and a means of searching for ways of communication in regions affected by ethnic or religious conflicts. The richness of cultural heritage arises from cultural diversity of countries and regions of the world [Prus et al. 2020].

All activities related to global cultural heritage are based on the UNESCO Convention Concerning the Protection of the World Cultural and Natural Heritage. The text of the Convention was adopted at the 17th session of the General Conference of the UNESCO in 1972 in Paris, France. According to the Convention, the following are distinguished: (1) tangible cultural heritage, which includes movable cultural heritage (paintings, sculptures, coins, manuscripts), immovable cultural heritage (monuments, archaeological sites, and so on), and underwater cultural heritage (shipwrecks, underwater ruins and cities); (2) natural heritage which includes, for example: natural sites with cultural aspects such as cultural landscapes, physical, biological or geological formations. According to UNESCO, *The intangible cultural heritage means the practices, representations, expressions, knowledge, skills – as well as the instruments, objects, artefacts and cultural spaces associated therewith – that communities, groups and, in some cases, individuals recognize as part of their cultural heritage* [UNESCO 2003]. Tangible cultural heritage refers to physical artefacts produced, maintained and transmitted intergenerationally in a society. It includes artistic creations, built heritage, and other physical or tangible products of human creativity that are invested with cultural significance in a society.

Over the years, the criteria for assessment of cultural heritage objects have evolved considerably. Initially, the particular cultural value of an object was determined by historical and artistic attributes. Currently, however, such features of objects as the cultural value, its value of identity, and the capacity of the object to interact with memory are taken into account as well. This evolution has also resulted in putting under protection of intangible cultural heritage which, for a long time, was ignored as heritage to be protected [Vecco 2010].

The term 'rural' conjures widely shared images of farms, ranches, villages, small towns, and open spaces. Yet, when it comes to distinguishing rural from urban places, researchers and policymakers employ a wide range of definitions [Cromartie and Bucholtz 2008]. The definition of rural areas is a much-discussed issue [Elands and Wiersum 2001, Šimková 2007]. Rural definitions can be based on administrative, land use, or economic concepts, exhibiting considerable variation in socioeconomic characteristics and well-being of the measured population [Cromartie and Bucholtz 2008].

Rurality and peripherality are topics very often discussed in the research of economists, geographers, sociologists and representatives of many other scientific fields, which makes these terms conspicuous [Novotný et al. 2015]. Currently, the popularity of the term 'rural area' is increasing in public discourse. It can be observed that this term is used in the context of development and modernity, while the term 'village' or 'the countryside' is used more frequently to describe the past [Vonderach 2006].

In geographical and planning literature, rural areas are most often understood in two ways: as a settlement unit (a village, a rural settlement, a locality), and as a space, area, land [Śpiewak 2012]. The popularity of the term 'rural areas' arises *inter alia* from the fact that these days, more and more socio-economic phenomena in extra-urban areas refer to particular territories. Rural development is based on certain territorial continuum which has various relations with administrative divisions [Ray 2006].

Rural areas are vital to the European Union as they cover almost 91% of the territory and hold over 59% of the population. Rural regions generate 17% of the gross value added and provide 22% of the employment [Giannakis 2014]. Rural areas include a great variety of cultures, landscapes, nature and economic activities that shape a palette of rural identities. Moreover, they are subject to major transformations. Agriculture is no longer the obvious pillar of the rural areas [Elands and Wiersum 2001]. Rural areas are currently undergoing significant economic and social changes, mostly induced by the international trade liberalisation, the development of information technologies and the strengthening of rural development policy [Giannakis 2014].

The idea of multi-functional development is sometimes regarded as a panacea for the problems of rural areas. The implementation of this model primarily involves the diversification of rural population's income sources. One of the components of multi-functional development of rural areas is economic activity which makes use of farm resources and qualities of the countryside, including cultural ones. An agricultural farm is a basic generating unit in agriculture, which is considered equivalent to a household. In addition to its primary production function, it also performs many other functions, which involves the economic diversification of rural areas and the implementation of the concept of multi-functional and sustainable development [Król 2018].

Over the last several years, rural areas have been undergoing significant socio-economic changes in which non-cultural economic activities have become very important. This is related to multi-functional development and activation of the rural population. Because of their natural character and diverse landscape, rural areas in Poland provide the inhabitants with increasingly better conditions for taking up non-agricultural economic activities; among the most popular ones are tourism services [Król 2019]. Rural tourism is presented as an additional source of income from offering lodgings for rent, and selling agricultural products and handcrafted articles [Flanigan et al. 2014]. A motivation for conducting business activity in rural areas also includes the need for self-fulfilment, sharing the passion and establishing social relations.

2.3. The scarecrow as a component of cultural heritage of rural areas

Since people began to cultivate land, birds have posed a hazard to crops, both at the sowing and harvesting stages. Hungry birds were able to deprive a family of their crops and brought them to hunger in the winter period. In order to prevent this, farmers began to invent and build scarecrows taking on the form of a man or a child, less often a woman, which watched over the fields [de Lima 2002].

Not so long ago, farming family members guarded their fields against wild animals and birds on their own. The principal weapons included shouting and whistling as well as throwing stones to deter birds. Over time, their activities have been taken over by a dummy patterned on a human figure [Król et al. 2019].

Scarecrows take on different forms but their design is often similar: it is usually based on crossed wooden poles or planks, or branches (Fig. 2.1). This support frame was covered with hay or straw, and then with worn out clothes (Fig. 2.2). The outfit was crowned with a hat and various items moving in the wind and producing sounds, e.g. aluminum cans (Fig. 2.3) [Król et al. 2019]. The story goes that in the past his outfit comprised articles removed from a dead man's wardrobe; one source, it would seem, for the scarecrow's long-standing association with things sinister and presences supernatural. Gaunt and solitary, he is a watcher and a keeper. Fixed, in a permanent state of wakefulness. Nameless, his vigil sees out all weathers. A knot of mysteries. An old soul. Honest to himself [Lorimer 2013, p. 178].

a)

b)

Photos: K. Król

Fig. 2.1. a and b. The strawmen of Iwkowa in the rural landscape (Iwkowa, Małopolska region)

The scarecrow is an inanimate creature that has taken the place of a farmer to serve as a guardian of crops. In order to increase the effectiveness of scarecrows, certain farmers used to equip them with specific propellers and ribbons with moved in the wind and set the entire character in motion [Chavarría and Valverde 2005]. Farias [1996] described the scarecrow in the following manner: *The scarecrow is a doll made from straw and wires, with a corduroy jacket and a straw hat*. Scarecrows usually took on a masculine appearance, probably due to the fact that most of the hardest field work were performed by men [Chavarría and Valverde 2005].

a)

b)

Photos: K. Król

Fig. 2.2. A scarecrow in the city of Kraków, Mydlniki (a); 'a rustling fence' protecting vegetable crops – Stary Sącz, the Małopolska region (b)

a)

b)

Photos: K. Król

Fig. 2.3. The strawmen of Stary Sącz in the rural landscape (Małopolska region)

Scarecrows are present in many cultures. There are numerous beliefs, customs and legends associated with them. Depending on the region in which they are found, they are referred to in different ways, from 'espantapájaros' in Spain to 'chuchelo (чучело)' in Russia (Table 2.1). There is also certain symbolism associated with the scarecrow who used to perform both a practical and symbolic-and-magical function. In certain cultures, the scarecrow was attributed supernatural abilities.

Table 2.1. The name 'scarecrow' in different languages of the world

National language	The name 'scarecrow' in a national language*	National language	The name 'scarecrow' in a national language*
French	épouvantail	Hungarian	madarijeszto
Spanish	espantapájaros	Romanian	sperietoare de pasari
Polish	strach polny	German	vogelscheuche
English	scarecrow	Russian	chuchelo (чучело)
Italian	spaventapasseri	Czech	strašák
Portuguese	espantalho	Chinese	dàocǎorén (吓唬人之物)

* Original spelling

Source: Authors' own study

The scarecrow has two faces. It is sometimes depicted as a nightmarish, cruel and evil character that can do harm [Chavarría and Valverde 2005], or as a guard of crops and home gardens, a good-natured and well-wishing guardian [Farias 1996]. In various cultures, the scarecrow symbolised life, strength and power [de Lima 2002].

2.3.1. Modern scarecrows

Humans have always been compelled to protect crops against birds and wild animals. In certain regions, however, the phenomenon of ravaging crops by birds and wild animals is intensified. The reason for this can be found in the specialisation of agriculture and the modification of agricultural settlements (elimination of hedges, a single-crop system, an increase in the plot size). Moreover, birds and wild animals have fewer and fewer wild areas at their disposal as well as fewer natural enemies. Populations of certain species are getting out of control, which is facilitated by the availability of food of anthropogenic origin (waste, landfills etc.). Consequently, in recent years the damage done to farmers by birds and wild animals has increased [Santilli and Azara 2014].

2.3.1.1. Acoustic deterrence

Many animal species use sounds to communicate with one another, to warn one another of a danger, or to deter predators. This fact is made use of by manufacturers of deterrent devices that emit various types of sounds. One of the most common devices of this type is a propane-butane-fueled detonator for deterring birds and animals. The device is comprised of a combustion chamber in which a pre-determined amount of gas is ignited by a sparking plug. The explosion is very loud, and the intervals between successive detonations are regulated. It is a simple and economical system which requires no presence of an operator. Noise, however, can be badly tolerated by humans, therefore the device should be used outside built-up areas.

The device usually operates at regular intervals, which allows animals to get used to the sound; therefore, its effectiveness is limited to a few days. A detonator is used to prevent damage caused by various bird species in winter cereals, sorghum, maize and sunflower crops; however, it can also be used in orchards and vineyards. It should be placed on an elevation and relocated every few days in order to increase the deterrence effectiveness. A detonator, if regularly relocated, can protect an area of 4–8 ha. The effectiveness of this device is improved where visual deterrence methods are applied at the same time [Higa Díaz 2009, Santilli and Azara 2014]. Ultrasounds are used to deter animals as well. A digital scarecrow emits a series of ultrasound waves with the aim of deterring birds and wild animals [Burns 2009].

2.3.1.2. Visual deterrence systems

The effectiveness of visual deterrence systems is limited in time as well as determined by the animal species. In order to deter animals visually, e.g. balloons with predator's eyes painted on them are used. These balloons, where provided in sufficient numbers, keep birds away from the crops. The alternate use of balloons of different colours prolongs the deterrent effect. The number of balloons used per area unit may vary; a satisfactory result can be achieved with approx. 10 balloons per hectare. It is recommended that balloons of a certain colour should not be used for longer than three weeks [Santilli and Azara 2014]. A deterrent effect is also produced by reflective strips cut out of plastic, which shine and make noises when exposed to wind.

The efficiency of visual deterrent systems is limited by their relative immobility. Animals quickly become accustomed to objects which remain motionless; for this reason, wind-driven scarecrows that rotate around their own axis have been developed. Kites with an image of a bird of prey painted on them are also effective. In windless conditions, the device is lifted by helium-filled balloons. The considerable altitude at which the kites can be used enables the protection of large areas at relatively low costs. Research has demonstrated that this method of deterrence is effective [Santilli et al. 2007, Gorreri et al. 2009].

In order to deter birds and wild animals, stationary predator decoys are used as well [Król et al., 2019]. Laser deterrent systems are also gaining in popularity. Study results demonstrated that laser beams efficiently deterred blackbirds [Homan et al. 2010]. Farmers believe that laser deterrent systems are more effective than cannon repellers or scare guns [Brown 2017].

2.3.1.3. Other means of deterrence

Protective nets are most effective in protecting crops against birds. They are most often used for specialised crops e.g. in the cultivation of vines or vegetables. However, the nets, where used improperly, may cause fatal injuries in birds. Various fences can also be effective, from brick or wooden ones to wire or barbed-wire nets and electric fences (Fig. 2.4).

a) b)

Photos: K. Król

Fig. 2.4. A rustling fence combined with barbed wire to protect vegetable crops – Stary Sącz, Małopolska region (a); a wire fence of a vineyard – Fattoria di Lamole Vigna Grospoli, Italy (b)

Chemicals are also used to deter animals. Anthraquinone-based products are the most effective way to prevent damage to maize and beet crops done by birds. The agent is in the form of a moistened powder which is applied onto the seeds and remains on a young plant [Santilli and Azara 2014].

In the protection of crops, the so-called reduction culling is applied as well; it enables the control of wild boar, bird or deer populations. It appears, however, that hunting activities alone cannot significantly reduce the size of populations, particularly those of birds. What is more, these methods are often socially unaccepted although being widely supported by the rural population [Król et al. 2019].

2.3.2. Scarecrows as an element of pop culture

Scarecrows have also found their permanent place in show business. One of the examples is the role of a 'bad guy', played by a scarecrow in an animation Scooby-Doo! Spooky Scarecrow. In this role, however, the scarecrow did not lose its rural nature, as he appeared as a ghostly character that disturbed the celebration of a harvest festival. What is more, the scarecrow played a villain in such movies as *Scarecrow* (2013) or *Curse of the Scarecrow* (2018).

The scarecrow has also terrified the audiences as a character from a 'Batman' comic book. The scarecrow appeared for the first time in a World's Finest Comics series in 1941; it was created by Bill Finger and an artist Bob Kane. The scarecrow also appeared in the first part of Nolan's trilogy (dedicated to the Dark Knight's struggles), in an animated series 'Batman' and in a computer game 'Batman: Arkham Knight'. He also starred in dramas and comedies, for example *Scarecrow* (1973) and *The Scarecrow* (1916). On the other hand, in childrens' books the scarecrow is depicted as a kind, helpful, colourful and friendly character, for example in a book from 2017 entitled *Nieustraszony strach na wróble* ('The Fearless Scarecrow') by Grzegorz Majchrowski. Moreover, the scarecrow is one of the main characters in a children's novel by Lyman Frank Baum entitled *The Wonderful Wizard of Oz* which is classified as a world literature classic.

2.4. The scarecrow as an indicator of cultural changes

The process which, based on quantitative and (or) qualitative characteristics of a single object (indicator), determines the state of another object, is referred to as indication. Most frequently, this definition is accompanied by the terms of indicator, indicated object or field of indication [Roo-Zielińska et al. 2007].

The term 'indicator', commonly used in science and practice, is derived from the Latin verb *indicare* which means 'to show', 'to announce', 'to evaluate' or 'to impose a price'. It is frequently used interchangeably with an equivalent term of 'index' [Roo-Zielińska et al. 2007]. According to the definition provided in a study by H. Inhaber [1976], an indicator is an indicating object (or a set of objects) whose presence, frequency of occurrence, distribution and other features are used to identify the phenomena and processes that are impossible, too costly or too labour-intensive to be examined directly.

An indicator is a quantitative or qualitative measure that can be evaluated in relation to the previously adopted criteria. Such an indicator describes, in an unambiguous, objective and verifiable manner, a specific ecosystem or social system, or the components of a policy being pursued, conditions of management or social processes that are significant from the perspective of ecological systems. It is not a perfect representation of reality as it only describes its aspects, depending on the methods selected and the specific purpose [Roo-Zielińska et al. 2007]. Indicators are sometimes used in environmental, landscape-related, social, food-related, economic or technical research.

They are also used in the assessment of landscape condition and functioning or changes in the natural environment [Olsen et al. 2007]. Such indicators include *inter alia* the soil, the condition of peat bogs or vegetation forms and structure. Temperature can be an indicator as well [Jackson et al. 1981], the level of technical and social infrastructure [Shen et al. 2010], food security [Leroy et al. 2015] as well as plant and animal species [Morellet et al. 2007, Siddig et al. 2016]. In social sciences, indicators may include, *inter alia*, law and order, state interventionism, market openness [Versteeg and Ginsburg 2017] or the accessibility of information technologies [Król 2019]. Heink and Kowarik [2010] recommend distinguishing between indicators as ecological components, i.e. ecological units, structures, or processes and as measures, i.e. properties of a phenomenon, body, or substance to which a magnitude can be assigned, and between descriptive and normative indicators. Indicators are useful for monitoring progress towards specific economic and environmental goals. For example, to monitor success in limiting emissions from the energy sector, it would be sensible to analyse indicators related to energy use and efficiency, and population and economic growth, and to identify the factors most responsive to policy changes [Vera and Langlois 2007].

Certain properties of an ecosystem can be measured directly (e.g. soil temperature or soil carbon content), while others can be statistically estimated based on sample data (e.g. population size) or predicted based on a model (e.g. soil erosion rate). There is, however, a whole group of characteristics and properties which are difficult to describe and unambiguously defined (e.g. environmental capacity, balance of matter transport, environmental quality). In order to present them, indirect measures are applied. Results of any measurements and analyses may be indicators. The indicator defined in this way includes the results of both direct measurements and statistical assessments as well as the results of modelling and the interpretation of substitute measures [Graham 1996, Roo-Zielińska et al. 2007].

Until a few decades ago, modern methods for deterring wild animals were not widely available, particularly in small localities. At that time, the erection of scarecrows in fields or home gardens was often practised. It was the scarecrow that was perceived as the main tool for crop protection, as opposed to technical innovations that were virtually seen as something 'devilish' in nature, which is likely to bring crop failure on a family. Until recently, technical inventions were approached in the countryside with a certain amount of mistrust. Political and economic transformations in Poland have affected the model of living and farming in the countryside. Land consolidation, economic development and legislation are only the selected factors due to which only the large-scale or specialised agriculture has become profitable. The mechanisation of agriculture and intensification of production have begun to tear away the countryside from tradition. Oral lore, traditions and customs have become 'unfashionable' or even gained opponents. In response to these changes, various initiatives have emerged, including bottom-up ones, with the aim of saving cultural heritage of the countryside. These initiatives involve cherishing and continuing traditions as well as searching for, preserving and promoting heritage, both tangible and intangible. Scarecrows have found their place in this trend, as not only do they perform their traditional function but also provide a specific 'cultural service'. They sometimes are the leitmotif of exhibitions, thematic routes and nature-ethnographic-historical trails. They are also used as a leitmotif of local festivals, competitions and cultural animations in rural areas. Sometimes scarecrows serve as a tourist attraction rather than scarers of wild animals [Król et al. 2019].

2.5. Discussion

Lormier [2013, s. 177] noticed that the existence of the scarecrow is variously reported: as having all but vanished and yet of making unexpected reappearances; as materially functional and complexly meaningful; as a figure summoned up by cultural memory and personal recollection; and as a focus for mixed feelings of loss, nostalgia, estrangement, and community. According to de Lima [2002], the scarecrow combines in himself two aspects: practical (pragmatic, functional) as well as symbolic and magical. The former only concerns the deterrent function. In turn, the latter includes symbolic systems and their magic as well. The scarecrow is considered equivalent to a mysterious character endowed with supernatural powers and capable of doing both good and evil, and he enjoyed such a reputation until recently.

Król et al. [2019] pointed out that the status of a cultural heritage object is not attached once and for all. What is of a special cultural value to a particular generation does not have to be of that to next generations. Future generations are likely to reject cultural heritage of their ancestors. This heritage may be either 'erased' or forgotten. This has been confirmed by the results of research into the perception of scarecrows by the rural population in Poland. The scarecrow, which is cultural heritage for the older generations of Poles, is perceived by the current generation as merely a straw dummy with neither practical applications nor cultural significance. Król et al. [2019] concluded that if the memory of legends and customs related to the scarecrow is not nurtured, the scarecrow will no longer be perceived in Poland as a cultural heritage object. The traditions associated with him will vanish, and the legends and beliefs will be forgotten.

2.6. Summary

There is no doubt that the practice of erecting scarecrows in the field is quite old. For the elderly inhabitants of Polish countryside, the custom is still alive as it was observed by parents and grandparents. This custom was passed from generation to generation. The elderly rural population still perceive scarecrow as being useful and necessary in the protection of crops. This, however, has changed due to the generational replacement. The new generation of farmers in Poland is approaching scarecrows with certain derision. The scarecrow no longer commands respect. He is ruthlessly held accountable for his effectiveness which, when faced with the increasingly tamed animals, is insufficient. Scarecrows are being replaced by mechanical, electric and electronic deterrent devices; this is primarily determined by the effectiveness of protection.

The perception of scarecrows is changing. Currently, they are becoming a relic of the past, and are considered equivalent to characters from fairy tales and legends while invariably being associated with rural areas. Scarecrows have become museum exhibits and stars of comic books or movies. One can meet them at rural fairs; at the same time, they are disappearing from fields under cultivation. Therefore, the scarecrow remains alive but its role is changing. He no longer serves its deterrent function; instead, he has taken a specific place in pop culture as a synonym of a fright, a torturer, an evil spirit, or, on the contrary, a good-natured travel companion.

The scarecrow is not trendy. It is analogue. The youth of today devote more time to mobile devices than to penetrating the secrets of nature. Large-scale agriculture needs no scarecrows. Today's farmers focus on the pursuit of production efficiency, maximisation of profits and minimisation of costs. This is why scarecrows can be spotted in Poland more often in mountainous areas in which there are more small farms which cultivate tradition and produce for their own use, and whose products can be bought locally or on the farm itself. Scarecrows find their place in small agricultural farms which keep traditions alive. Polish traditional agriculture still recognises and honours their cultural significance, and still treats them as a component of cultural heritage of rural areas. In small agricultural farms, scarecrows are not merely a tool that is supposed to serve its functions; instead, they gain subjectivity. They gain a soul.

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3

From scarecrows to socio-economic development in rural America

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Abstract. The rural communities in the United States continue to be meaningful not only to their citizens but to the nation as a whole, yet many rural areas simply lack the resources necessary for sustained growth and economic and social viability of their development. As technology has evolved, rural America has not only developed but also utilized various technologies to improve the yield and production of farmland. Most recently, broadband connectivity has played an important factor in U.S. rural economic development, including agriculture, healthcare, education, and communication. Rural resilience, rural digital inclusion, rural information, and communication technologies will become more crucial for the development of rural America today.

Keywords: rural development • resilience • digital inclusion

3.1. Introduction

Farming is still a principal source of income and employment in many counties in the rural United States; however, farm consolidation, increasing productivity, and labor-saving technology have led to a significant decline in farm employment. Nationally, the number of farm jobs fell by 14.1 percent between 2001 and 2013. During the same period, total farm earnings increased 63.4 percent (in real terms), according to data from the Bureau of Economic Analysis. Farming dependence has become more concentrated in rural counties, while farm dependence has dropped more sharply elsewhere.

As rural counties have evolved, the use and implementation of technology have dramatically changed. Early Native Americans and early immigrants from Europe used scarecrows to ward off predators in crops. As technology has evolved, rural America has not only developed but also utilized various technologies to improve the yield and production of farmland. Most recently, broadband connectivity has played an important role in U.S. rural economic development, including agriculture, healthcare, education, and communication. Due to the modern world economy's reliance on interconnectivity, a lack of adequate access to Internet connectivity could produce a negative impact on rural communities. Rural resilience, rural digital inclusion, rural information, and communication technologies will become more crucial in the development of rural America today.

Our purpose is to explore the intersection of broadband Internet infrastructure and the digital technologies that will depend on improved e-Connectivity. The U.S. Department of Agriculture (USDA) has embarked upon this analysis to estimate the possible economic benefits of expanding rural e-Connectivity to farms and ranches and to explore what's needed to expose this potential.

3.1.1. Susceptibility to recession in rural America

As noted by Ring, Paredo, and Chrisman [2010], many small rural communities have shown economically depressed throughout the United States. The economic disparities within rural America are caused by disadvantages related to smaller markets, isolation from larger more populous regions, lower-skilled labor, and lack of access to technology [Ring et al. 2010]. As the overall U.S. economy experienced expansion during the 1990s, Drabenstott [2000] found that many rural locations did not experience economic growth. Rural America's isolation and lack of access to skilled labor, technology, and large market economies lead to disadvantages and susceptible economic systems.

An area of concern to rural America is the loss of population and the impact this has on small local economies. In the formative study of Driscoll et al. [2012], the authors hypothesized the relationship between healthcare service and outmigration trends in Alaska's rural communities. The survey results showed that factors that contributed to the depopulation of rural communities included limited access to primary and specialized healthcare, perceptions of health risks, and the influence on the migration of friends and family. They confirmed that the growing influence on health concerns and healthcare delivery was a major cause of the outmigration in the underserved population areas.

Theodori and Theodori [2015] analyzed data from the Rural Youth Community Survey to examine the outmigration intention of youth through the local association, attachment to one's hometown, and educational aspirations of the community in Texas. The result of their multivariate logistic regression revealed that the three measures are independently and significantly associated with students' intentions to migrate out of the rural areas. Recommendations on leadership development, youth engagement, and entrepreneurship strategies are provided for community leaders to retain youth in their rural areas and encourage young people to return to their home communities after receiving post-secondary education or training.

Briddle and Azano [2016] conducted a systematic review of the literature on rural teacher recruitment, retention, and training as a case study to examine the constancy and change in the structure of the rural school problem. They explained that attention to rurality as a factor affecting education boomed in the first half of the twentieth century and early twenty-first century. In conclusion, they suggested that if education in the U.S. rural areas could create parity and equity to cities, then the outmigration situations of rural communities could perhaps be reversed.

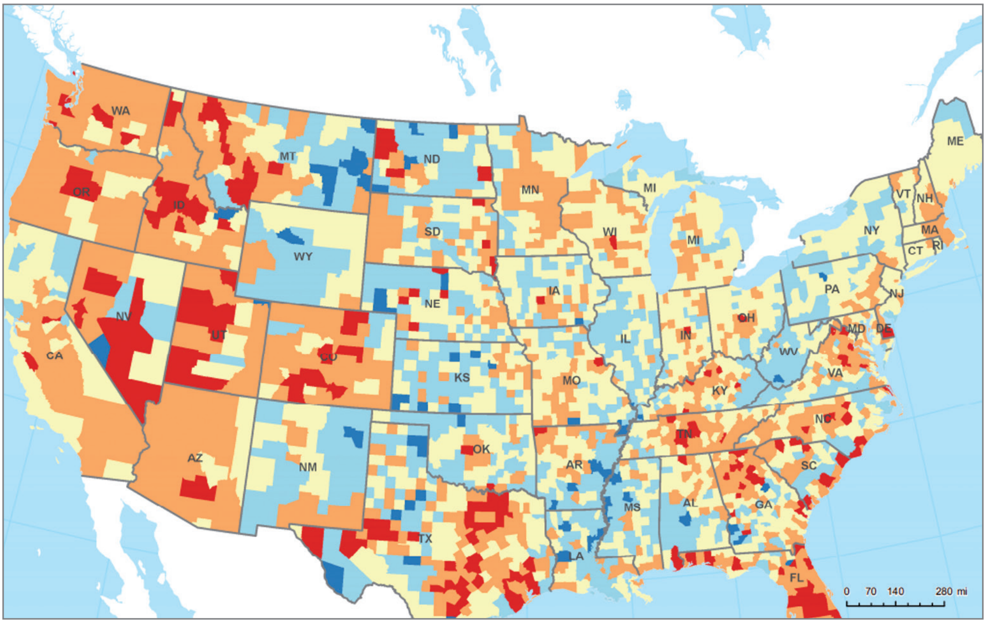
Benjamin [2020] mentioned a pandemic could impact the nearly 30% of new U.S. farmers who have been in the business for less than 10 years. New farmers have started vibrant and diverse rural farming communities from Washington to New York in the past decade. However, in recent years, these new farmers are the most economically vulnerable group in terms of their business plans, farm finances, marketing opportunities, and farming viability in the local farming communities.

In many cases, rural resources are owned and controlled by urban interests and corporations, including agricultural and natural resources, the processing, distribution, marketing of food, energy, and other resources. Baily et al. [2014] pointed out that we have a long tradition of tracing population changes and how they are affected by the accessibility of healthcare, education, and other vital social services. Some rural sociologists have noted that rural areas are a storehouse of energy and resources of food and fiber. Ecosystem services of clean air and water depend on rural landscapes and the people who live there. A rural area is not in a marginal economic term, but rather is tied intimately to and shares a common fate with the urban communities.

3.2. Rural areas in the United States

3.2.1. Defining rural

There are difficulties in both defining the term rural and in being able to rely on this term's substantive meaning. The Center for American Progress has gathered data from the U.S. Census Bureau and the Atlas of Rural and Small-Town America from the U.S. Department of Agriculture's Economic Research Service. Analysis from these available data is based on a binary delineation of metro and non-metro. Furthermore, the reports expand these categories to incorporate degrees of rural areas. The urban-rural continuum defined in the Economic Research Service categorizes counties by population and proximity to cities, providing a relational dimension to the collected data.



Population change rate, 2017–18

Note: map shows all couties
Units: Percent Date: 2/25/2020

- –6.5% – –2%
- –1.9% – –0.5%
- –0.4% – 0.5%
- 0.6% – 2%
- 2.1% – 11.8%
- No data

Source: USDA, Economic Research Service (2019). *Atlas of Rural and Small-Town America.* https://www.ers.usda.gov/data-products/atlas-of-rural-and-small-town-america [accessed: February 17, 2020].

Fig. 3.1. Population movement in U.S. non-metro counties

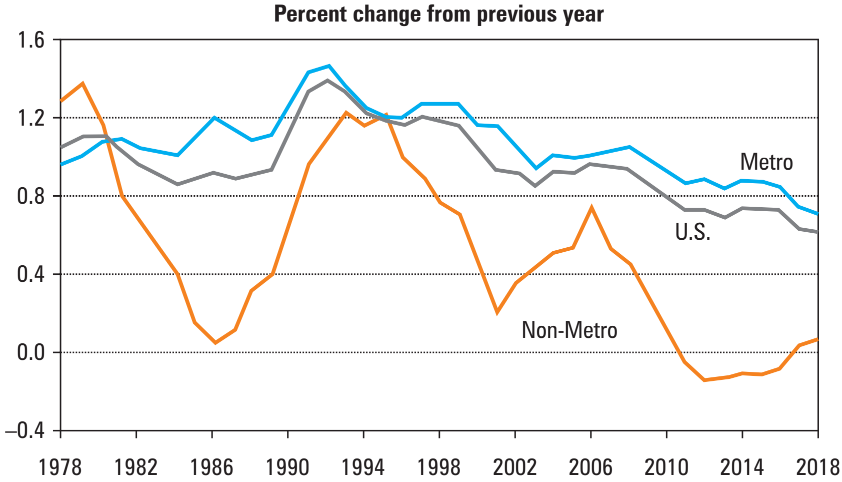
This use of the metro/non-metro delineation to designate rural areas where non-metro is used as a proxy for rural is common. It does, however, have limitations that should be acknowledged. First, while there is some overlap, the metro/non-metro delineation does not fully match the rural-urban delineation used by the Census Bureau. Second, a problem with this binary delineation between metro and non-metro is that a county's classification may change over the years due to fluctuations in population. This makes a substantive interpretation of the term rural difficult over time. The level of population shifts in non-metro areas that we refer to here is reflected in Figure 3.1, which displays a population movement in many areas in the United States of over 10%. Third, the term 'rural' has a broader cultural meaning not fully captured by the demographic data. For example, many Americans living in metropolitan areas describe their communities as rural areas. This could signify that a far more diverse swath of American communities resides in rural communities than can be captured by the binary delineation metro and non-metro. Yet, in the absence of clearly defined measures of the term rural, we understand that the non-metro designation is not only widely used but offers a degree of utility in differentiating less from more populous areas.

3.2.2. Rural non-metro population shifts

Non-metro counties contained 46.1 million residents in July 2018 and this represented 14.1 percent of the total population in the United States, according to the latest estimates from the U.S. Census Bureau [Pender 2019]. This compares with 46.3 million residents in July 2010, a 0.4-percent decline during this period. Renewed population growth since 2016 (non-metro counties added an estimated 54,000 residents during 2016–2018) did not offset the loss of 260,000 people during 2010–2016, which was the first period of non-metro population decline. The overall population loss from 2010 to 2018 resulted from a historically low population gain of 272,000 non-metro residents from natural change (births-deaths), which did not offset population loss of 478,000 from net outmigration (more people moving out of non-metro counties than moving in).

Rates of population change varied across the rural-urban areas during 2010–2018, from a nearly 7% increase in metro counties to a nearly 2% decrease in completely rural, nonadjacent counties. Non-metro population growth during this decade occurred in non-metro counties proximate to (often adjacent to) metro counties. In these non-metro counties, high rates of natural increase (compared with other non-metro counties) more than offset population loss from outmigration. In other non-metro counties, the natural decrease in population due to factors such as declines in fertility rates and population aging combined with outmigration accounted for population loss. Outmigration from non-metro counties fluctuates with the business cycle and tends to be particularly high during periods of economic boom [Pender 2019, Swenson 2019, Van Dam 2019].

According to the most recent report from USDA, Economic Research Service (ERS), the US rural population, as defined as population growth in non-metro counties, has started to increase in 2018. While there has been variation in growth across counties nationally (Fig. 3.2), the overall shift has been in the positive direction [USDA ERS 2020].



Source: USDA. Ag and Food Statistics: Charting the Essentials, February, 2020. Economics Research Service, Administrative Publication, 2020, Number 083, p. 7.

Fig. 3.2. Population change in non-metro counties, 1978–2018

3.2.3. The U.S. rural economy

The United States rural economy includes food producers, manufacturers, food stores, and restaurants. Agriculture and its related industries account for 11.0% of U.S. employment and 5.2% of the U.S. Gross Domestic Product according to the USDA report in 2020 [USDA ERS 2020]. The food sector is ranked third behind the housing and transportation sectors in the U.S. households' expenditures in 2018. Recent trends showed a relatively slow growth of employment and population in rural areas and continued higher poverty levels than in urban areas. The trends differ widely across rural America, indicating that the gap between rural and urban indicators of economic wealth persists. However, as previously noted, losses to the rural population began to reverse in 2018.

The United States agricultural production depends heavily on the Nation's land, water, and other natural resources, which directly impact the quality of the natural environment. Over half of the U.S. land base is used for agricultural production or representing the primary use of land. In the U.S., the states of Nebraska, California, Arkansas, Texas, and Idaho are the major agricultural states, accounting for half of the irrigated agricultural land in the Nation. The mix of conservation efforts of the USDA has shifted from removing environmentally sensitive land to farming production. The Conservation Reserve Program (CRP) and other conservation programs focus their efforts on maintaining land, improving water quality especially, reducing erosion, and maintaining wildlife habitats.

Early in the twentieth century, agriculture was labor-intensive and cropped up on many small and diversified farms. Much of today's agricultural production takes place on large and specialized farms [Dmitri et al. 2005]. The number of farms has leveled off at about 2 million, with 1 billion acres of land, and 4,500 acres per farm. Agricultural output has grown, along with improvements in agricultural productivity and the stable farm inputs over the past seven decades. Net farm income has increased since 2016 but remains below its 2013 peak. Off-farm income continues to be important for total farm household income, especially among small-scale producers [Hoppe et al. 2010, Newton 2019].

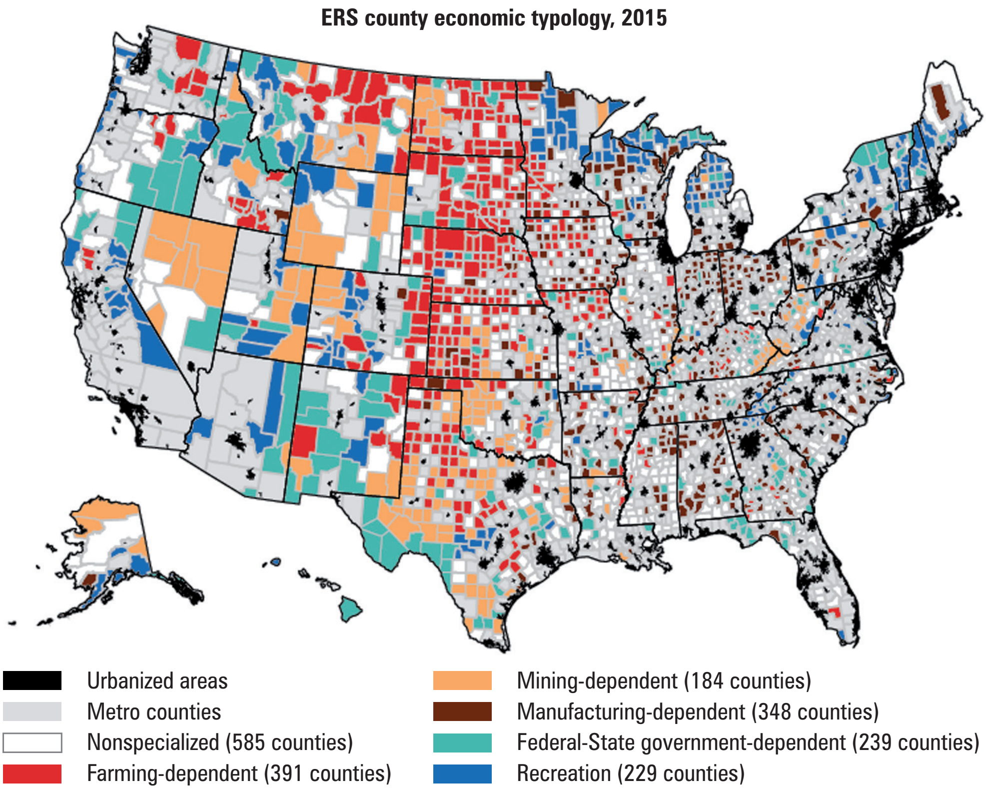
Markets for major agricultural commodities are reflected in the supply-and-use conditions and these various markets have an impact on agricultural commodity prices. As an example, corn production and prices are impacted by various uses, including consumer food, fuel, sweeteners, etc. which have an impact on feed costs in the livestock sector. The U.S. crop production is concentrated in California and the Midwest, while livestock production is dispersed across the country. Corn and soybean acreage has increased since 1990, while fewer acres are planted with wheat. Agricultural prices remain below their 2014 peak and directly affect farm sector cash receipts.

The primary U.S. exports are grains, feeds, soybeans, livestock products, fruit, vegetables, and other horticultural products. The primary U.S. imports are horticultural and tropical products. Canada, Mexico, and East Asia are major U.S. trade partners. The United States exports more agricultural goods than it imports, but imports have grown faster and more steadily than exports over the past decade. The U.S. agricultural exports grew slightly in 2018, driven by gains in all major commodity groups except oilseeds and oilseed products. Canada, Mexico, and the European Union were the major destinations for U.S. agricultural exports in 2018. Overseas customers account for 40 percent or more of the U.S. cotton, almonds, rice, soybeans, and wheat production.

The major retail food price components are costs of packaging, processing, transportation, and other marketing advertisements along with competitive factors that play a greater role in determining prices on supermarket shelves and restaurant menus than farm level of commodity prices [Schnepf 2015]. Even large swings in farm commodity prices resulted in modest changes in food prices over the past two decades. These modest price changes in commodities resulted from the fact that much of Americans' retail food dollar pays for more stable processing, retailing, and foodservice costs. Expenditure on food away from home continued to outpace food-at-home expenditure in 2018.

3.2.4. Industrial diversity in rural areas

Most discussions about industries in rural America tend to revolve around agriculture, manufacturing, and mining sectors. Some economists even point to disruption in these industries as the reason for the economic decline in rural America. The loss of manufacturing jobs due to globalization and automation, for example, has hit rural economies harder than the rest of the country. In addition, some policymakers have criticized regulations of fossil fuels and greenhouse gas emissions because of their negative impacts on mining communities [Low 2017, Ebbs 2018, Rowland-Shea 2018].

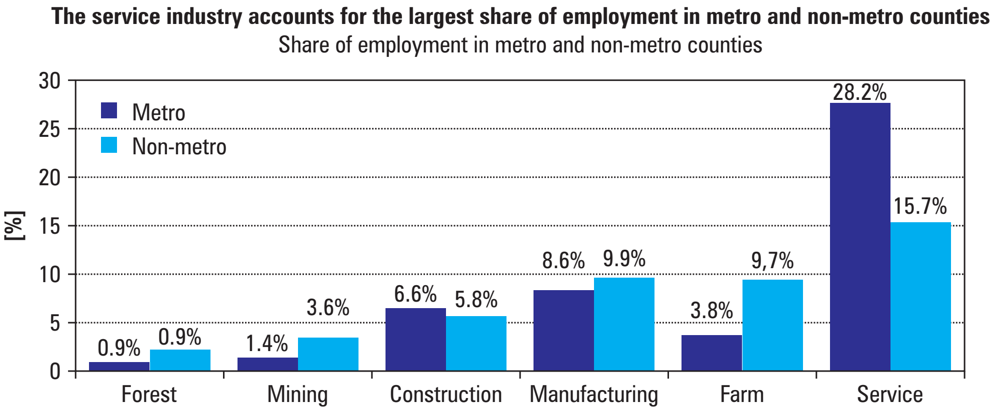


Source: USDA. Ag and Food Statistics: Charting the Essentials, February, 2020. Economics Research Service, Administrative Publication, 2020, Number 083, p. 8.

Fig. 3.3. U.S. County economic typology, 2015

Mining, agriculture, or manufacturing industries provide major economic benefits in many U.S. rural counties. However, many rural counties' economies are not based on these industries, and because they lack natural resources, i.e. arable land or mineral deposits, they cannot obtain such a comparative advantage. Consequently, it creates a disparity for policymakers who promote these select industries to support the well-being of all rural inhabitants [Ajilore and Willingham 2019].

While agriculture, manufacturing, and mining are important industries to many rural communities (Fig. 3.3), these industries do not characterize all rural economies. As shown in Figure 3.5, the service sector comprises the largest portion of employment in non-metro economies as well as in metro economies overall. Metro areas' share of employment in the service sector is almost double of the non-metro areas in Figure 3.4. The agriculture sector does account for a larger share of employment in non-metro counties, but manufacturing employment rates are similar between non-metro and metro areas.

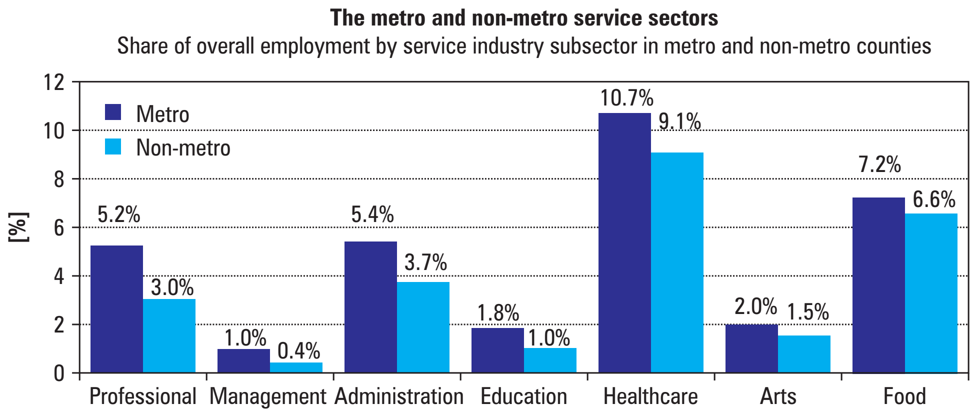


Source: Ajilore and Willingham [2019]

Fig. 3.4. Economic sectors in metro and non-metro counties

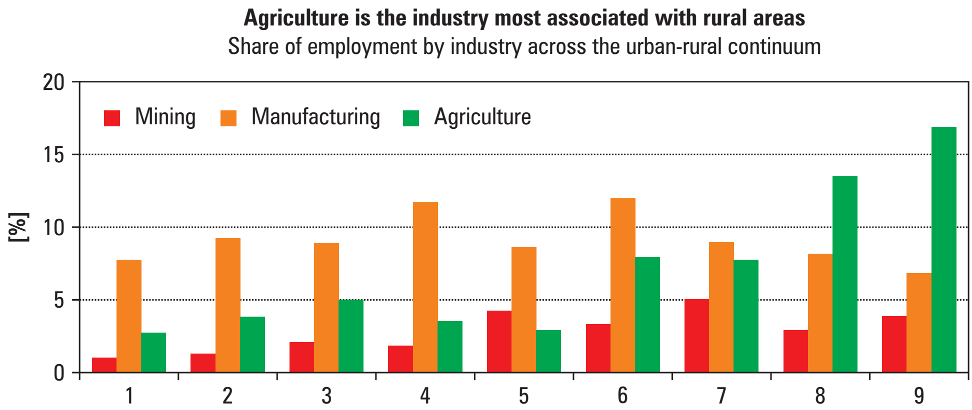
The service sector encompasses many industries displayed in Figure 3.5, and the health care and food services industries dominate employment within the service sector in both metro and non-metro areas. The distribution of various service sector industries is similar for both metro and non-metro areas, though the level of employment is uniformly lower in non-metro areas.

The picture regarding industrial composition changes dramatically when viewed from the vantage point of 'rurality', defined as population density. Figure 3.6 shows that the sector most associated with sparsely populated areas is agriculture. For sparsely populated, highly rural areas, agriculture becomes essential to local econo-



Source: Ajilore and Willingham [2019]

Fig. 3.5. Metro and non-metro service sectors



Code	Population
1	Metro area with a population of at least 1 million
2	Metro area with a population between 250,000 and 1 million
3	Metro area with a population fewer than 250,000
4	Nonmetro area with an urban population of 20,000 or more, adjacent to a metro area
5	Nonmetro area with an urban population of 20,000 or more, not adjacent to a metro area
6	Nonmetro area with an urban population of 2,500 to 19,999, adjacent to a metro area
7	Nonmetro area with an urban population of 2,500 to 19,999, not adjacent to a metro area
8	Nonmetro area with an urban population of less than 2,500, adjacent to a metro area
9	Nonmetro area with an urban population of less than 2,500, not adjacent to a metro area

Source: Ajilore and Willingham [2019]

Fig. 3.6. Employment across industries in metro and non-metro areas

mies. Manufacturing is relatively more important to local economies in small to mid-sized non-metro areas, especially when adjacent to a metro area as shown in Figure 3.6 with codes 4 and 6. Though never the dominant industry, mining becomes comparatively more important in mid-sized non-metro communities, particularly those not adjacent to a metro area in Figure 3.6 with code 7.

Agriculture accounts for nearly 17 percent of employment in highly rural, less populous areas [USDA ERS 2019]. Agriculture-dependent economies are largely located in the central United States, running from the northern U.S. border with Canada, through Montana and Nebraska and extending into northern Texas. Unfortunately for these sparsely populated communities, the agricultural sector in the U.S. is far from healthy, with projected farm income in the bottom quartile of all years since 1929. Aggressive policy solutions are needed to tackle corporate concentration and power, empower farmers to negotiate fair prices, and ensure that farmers receive a fair share of the products of their labor [Willingham and Green 2019].

3.2.5. U.S. rural business & economic development

While oft-times painted in tones of an idyllic lifestyle, various studies have indicated that for many residents of rural areas, life can be more challenging when compared to their non-rural counterparts. For example, for those over age 65, social isolation may be more pronounced in rural than in urban areas. Also, in rural areas older Hispanic and black residents, in particular, may need health intervention services to maintain mental and physical well-being [Baernholdt et al. 2012]. A further example is household food insecurity. A comparative study found household food insecurity to be greater among rural than urban residents, particularly among rural women [Sharkey et al. 2011]. This relationship resulted in a higher rate or fair-to-poor health among rural than among urban women [Sharkey et al. 2011]. There are varied health-related disparities between rural and urban dwellers in the United States [see e.g., Miles et al. 2010]. Rural communities, for instance, have come to serve as a dumping ground for urban areas with hazardous waste sites and landfills located in rural areas [Lichter and Brown 2011]. The economic foundations of many rural communities, it seems, have been unable to provide in some cases the same quality of life found in urban communities, as businesses in rural areas prove less able to capitalize on firm characteristics and behaviors that may influence innovation creation than are firms in urban areas [Aryal et al. 2018].

To assist rural business, USDA Rural Development provides a loan portfolio of over USD 224.5 billion and oversees program loans, loan guarantees, and grants nearly USD 16 billion. The program offers loans to rural businesses through banks, credit unions, and community-managed lending pools to promote economic growth. In addition to loans, this rural development program also provides technical assistance and information to agricultural producers and cooperatives for establishing and improving the effectiveness of their operations. The technical assistance includes helping communities implement community empowerment programs. Overall, these programs and technical assistance would benefit rural residents to buy or rent a safe and affordable housing and improve their homes [Walter 2019].

In some areas, USDA Rural Development provides funds to local organizations, called 'Intermediaries', which use funds to offer loans and grants for business startup or expansion. These re-lending options or intermediaries include the Intermediary Relending Program (IRP), Rural Economic Development Loan and Grant Program (REDLG), and Rural Micro-Entrepreneur Assistance Program (RMAP). For cooperatives and agricultural producers, re-lending options are an essential portion of the U.S. economy. In addition to services of marketing farmers and ranchers' products as well as acquiring farm supplies, cooperatives offer assistance in obtaining housing, food, electricity, telecommunications, credit and financial services, hardware and building supplies, and other services.

Another development program for rural communities is the Rural Cooperative Development Grants (RCDG). These include Value-Added Producer Grants, Rural Development Energy Programs, Socially-Disadvantaged Group Grants, and Financing to Start or Expand a Business. These programs stimulate rural business creation and development by providing financial sponsorship and technical assistance. Also, the programs provide opportunities to partnerships with public and private community-based organizations and financial institutions for financial assistance, business development, and technical assistance to rural businesses. Another function of the program includes Business & Industry Loan Guarantees and Rural Business Development Grants (RBDG) [USDA Rural Development 2020].

3.3. Rural resilience

Rural communities across America occupy 95% of the landscape with a wide variety of small towns, woodlands, farms, fisheries, grasslands, and deserts. Less than 20% of the American population (approximately 60 million people) serve the vital role of stewardship of rural lands and watersheds. These hearty rural residents of sparsely populated landscapes are caretakers of nature's services that they all depend on for air, water, and food. As temperature and precipitation patterns are changing, the rural natural systems and communities are increasingly impacted by more frequent and severe storms, floods, drought, illness, invasive species, infrastructure damage, and more. The impacts of extreme weather and related risks add stress to rural communities already struggling with a lack of resources. Despite the importance of managing rural lands for climate resilience, underserved rural communities often lack the capacity or support to tackle climate impacts on their own [Griffith 2018].

To address this challenge, the collaborative Resilient Rural America Project (RRAP) is underway to meet the specific needs of rural America for effective climate resilience strategies. The major goal is to accelerate rural climate actions for resilience by understanding and meeting particular rural needs as well as strengthening the delivery of training and support for rural and small-town communities. The project will create targeted methods to overcome obstacles in rural America and equip adaptation professionals with the best methods to meet the needs of underserved rural communities.

The National Association of Counties' (NACo) Resilient Counties Initiative works to strengthen county resiliency by building leadership capacity to identify and manage risk and allow counties to become more flexible and responsive. Through the use of sustainable practices and infrastructure, counties will be better prepared to address these issues in a manner that can minimize the impact on local residents and businesses, while helping counties save money. For example, hurricanes, wildfires, economic collapse, and other disasters can be natural or man-made, acute or long-term, and foreseeable or unpredictable. Preparation for and recovery from such occasions requires both long-term planning and immediate action.

Through the initiative, NACo has the major responsibilities to:

- Develop strategies to foster economic growth and competitiveness.
- Educate counties on techniques for implementing resiliency and sustainability strategies.
- Provide tools for counties to educate their communities on resiliency initiatives.
- Identify ways to leverage changing conditions and take advantage of new technologies and innovation.
- Facilitate an open exchange with the private sector.

3.3.1. Digital access

3.3.1.1. From scarecrows to broadband in the rural America

In the early Native American cultures, people used scarecrows in the crop fields. Before the European emigrants arrived in North America, native adults would sit on the elevated stands to shout at birds or ground animals when they drew near the crops. Some native tribes even discovered they could soak corn seeds in a toxic herb mixture to deter birds away. Moreover, many Native American children in the Southwest areas had performed contests to make the most frightening scarecrows. The Zuni tribe used lines of cedar poles strung with cords and animal skins to keep birds away from their crops.

As waves of immigrants came from Europe to North America, they continued the practice of using scarecrows in their crop fields. German settlers in Pennsylvania, for instance, brought with them the bootzamon, or bogeyman, to stand guard over croplands or orchards [Wigington 2019]. Scarecrows became particularly popular during the period of America's agricultural development. After World War II, farmers in the United States sprayed pesticides, such as DDT, to more effectively protect their crops. While we have come to know that pesticides are harmful to humans, currently we do not see many scarecrows guarding fields. A symbol of seasonal change in the United States, the scarecrow has become a popular fall decoration.

In recent years, many new devices of scarecrows have been invented and adopted in the United States' rural landscape. A peregrine falcon, which is equipped with a remote-controlled 3D-printed raptor robotic bird, can swoop and soar to frighten real birds. The sonic bird cannon craftily plays the sound of shotgun blasts to signal imminent danger for many birds. The raucous explosions are broadcasted by digitized recordings of specific bird distress calls. Some high-tech motion-driven models hurl water at any intruder that strays onto the territory. There is also a hawk-like drone that features a GPS-guided autopilot mode, which can be programmed remotely, patrols a sprawling property, and generates a deafening whir. The drone has a built-in megaphone to broadcast distress cries and predator calls to fright intruders. The solar-powered 'scarecrow' with its long twin wings spins around to scare away prowlers. Also, the solar-powered robot wolf is designed to scare wild boar, deer, and other animals [Wilson 2019].

3.3.1.2. E-Connectivity in rural America

In January 2018, the Task Force on Agriculture and Rural Prosperity summarized initial findings to the President of the United States. The report was composed of how to promote agriculture, economic development, job growth, infrastructure improvements, technological innovation, energy security, and quality of life in rural America. The initiative recognized achieving e-Connectivity in rural America as a central mainstay, and President Donald Trump led the way by creating the American Broadband Initiative, which reflects the work of his Cabinet to support the private sector's expansion of rural broadband and effectively steward Federal tax dollars in that partnership. The USDA response to this call to action is intended to convey high level and broad concepts about the potential benefits of connected agriculture technologies to policymakers, industry leaders, and those who are affected by the lack of high-speed Internet service in rural areas that are limiting greater productivity and profitability for small producers. Lack of access to broadband Internet in rural communities is stifling American innovation, undermining potential advancements in food security, food safety, and environmental sustainability.

The Next Generation Precision Agriculture (NGPA) initiative can be considered an interdisciplinary science leading to breakthroughs and incremental technology advances to improve agricultural productivity, efficiency, and/or sustainability. Enabled by digital tools and connectivity, the NGPA is beginning to be applied across the entire food value chain, which produces benefits to producers and consumers. The concept of 'precision' in agriculture is not new, and the practice called Precision

Agriculture has always included infield processes aimed for more accurate planting, nutrient and pest management, as well as harvesting. Yet, until recently, the Precision Agriculture lacked data collection and analysis that is enabled by the 21st-century technologies and Internet connectivity. This next generation of technologies will continue to evolve, build innovation, and ingenuity into this vital American industry.

Likewise, the definition of broadband continues to develop, historically by increasing the speed of Internet connections, with a download speed set higher than upload speeds. Currently, the Federal Communications Commission's (FCC) classification of 'high-speed Internet' is 25 megabits per second for the download speed and 3 megabits per second for the upload speed. This places more emphasis on data flowing to the end-user rather than being uploaded from the end-user. Today, some NGPA technologies require these speeds, while some do not, and instead, data can be transmitted intermittently. However, as technology advances and the volumes of data to manage agriculture production grow, higher speeds will likely be necessary, requiring more symmetrical data flows, with a better balance of download and upload speeds and reliability.

For many years, the agricultural industry sector and its institutions, including USDA, have been active in various aspects of researching and supporting the usage of NGPA technologies, as well as investing in rural broadband infrastructure. But the interdependency of agriculture technology adoption and broadband infrastructure has not yet been evaluated at a nationwide scale, with a synthesis of the economic impact they both could incur.

3.3.2. Access to information and communication technologies

E-Connectivity for all rural Americans is a modern-day necessity to ensure reliable and affordable high-speed Internet e-Connectivity, or electronic connectivity (USDA. Broadband 2020). Throughout the U.S., one aim of governmental agencies is to ensure economic growth across cities and localities as well as to provide access to affordable high-speed Internet for rural communities is an essential component of this growth. Access to high-speed Internet is vital for industries that characterize rural community economies, *including agricultural production, manufacturing, mining, and forestry that acts as a substance for rural prosperity by enabling efficient, modern communications between rural American households, schools, and healthcare centers along with markets and customers around the world* [USDA. Broadband 2020]. Access to information technology is vital to rural communities, allowing them to retain business and to, therefore, remain economically viable. However, the low population density of rural communities can make it difficult for rural areas to support expensive technology investments such as broadband [Holifield 2003]. Since e-Connectivity being an essential requirement in our information-driven economy, the Agriculture and Rural Prosperity Task Force recommended this accessibility for all rural Americans.

Studies indicate that a disparity in high-speed Internet access between urban and rural communities, though perhaps narrowing, has nonetheless been an ongoing feature of life in the United States [see e.g., LaRose et al. 2007, Whitacre 2010, Basu and Chakraborty 2011]. While multiple factors can account for this gap, such as a lagging rural infrastructure, differences in individual skill-sets, and variances in perceptions regarding the usefulness of the Internet between rural and non-rural residents. A recent report by the FCC showed that 80 percent of the 24 million American households in rural areas do not have reliable and affordable high-speed Internet [USDA. Broadband 2020].

To help address the problem of the lack of high-speed Internet access among rural communities, on December 12, 2019, U.S. Secretary of Agriculture, Sonny Perdue, announced the availability of the second round of funding under the ReConnect Program. *The USDA will create USD 200 million for grants, up to USD 200 million for 50/50 grant/loan combinations, and up to USD 200 million for low-interest loans* [USDA. Reconnect 2020]. Utilizing loans, grants, and a combination of both, the ReConnect Program provides federal financing to enable the broadband deployment into rural America. Rural areas eligible for ReConnect program financing are those who don't have access to minimal broadband, which is defined as 10 megabits per second (Mbps) downstream and 1 Mbps upstream [USDA. Reconnect 2020]. The ReConnect Program will also incentivize investment from the private sector to deploy the broadband infrastructure. By doing so, more rural communities will ensure access to high-speed Internet with e-Connectivity for individuals, businesses, and public sectors.

3.3.2.1. Section 706 of the Telecommunications Act of 1996

Federal Communications Commission [FCC 2018] stated that Section 706 of the Telecommunications Act of 1996 requires the FCC to report annually on whether advanced telecommunications capability *is being deployed to all Americans in a reasonable and timely fashion," and to take "immediate action if it is not*. Advanced telecommunications have been defined by Congress as a high-quality capability that allows users to originate and receive high-quality voice, data, graphics, and video services [FCC 2018]. Following previous reports, the 2018 Broadband Deployment Report noted that fixed and mobile services meet the Congressional definition of advanced telecommunications. However, due to limitations in bandwidth in mobile data, mobile services are not currently complete substitutes for fixed services.

Before 2015, the FCC Title II Order, between 2012 to 2014, the fixed broadband Internet access was available to 29.9 million people who never had it before, including 1 million people on tribal lands [FCC 2018]. In addition, from 2012 through 2014, the FCC [2018] also found that mobile LTE broadband was made available to 34.2 million people, which included 21.5 million rural households in the United States. However, in the two years, after the Title II Order was adopted, *new deploy-*

ments dropped 55 percent, reaching only 13.5 million people, including only 330,000 people on tribal lands [FCC 2018]. Also, in the two years after the Title II Order, *new mobile deployments dropped 83 percent, reaching only 5.8 million more Americans, including only 2.3 million more rural Americans* [FCC 2018].

As of 2016, access to fixed terrestrial broadband with speeds of 25 Mbps/3 Mbps had increased from 89.4% in 2014 to 92.3%. However, over 24 million Americans still lacked the fixed terrestrial broadband at speeds of 25 Mbps/3 Mbps [FCC 2018]. In addition, the mobile broadband deployment has lagged in rural and tribal areas, or a lack of reasonable mobile broadband deployment. While urban areas had an increase of 10 Mbps/3 Mbps mobile LTE from 81.9% in 2014 to 90.5 % in 2016, a deployment of mobile broadband to rural and the tribal areas remained flat at about 70% and 64%, respectively [FCC 2018]. Thus, *approximately 14 million rural Americans and 1.2 million Americans living on tribal lands who still lack mobile LTE broadband at speeds of 10 Mbps/3 Mbps* [FCC 2018].

As of 2018, the FCC estimates that approximately 92% of the population has access to either the fixed broadband services of 25 Mbps/3 Mbps and the mobile LTE at speeds of 5 Mbps/1 Mbps. While almost 97.8% of Americans in urban areas have access to both fixed and mobile broadband, only 68.6% of Americans in rural areas can access both services [FCC 2018]. As of 2018, 85.3% of all Americans have access to fixed broadband speeds of 25 Mbps/3 Mbps and 10 Mbps/3 Mbps LTE services, including 61% of the population in rural areas evaluated and 89.8% in the evaluated urban areas [FCC 2018]. The 2018 Broadband Deployment Report found that the fixed terrestrial service of 10 Mbps/1 Mbps is available to 96% of the United States, 25 Mbps/3 Mbps service is available to 92.3% of the population, and 50 Mbps/5 Mbps service is available to 90.8%. However, the rural areas and the tribal lands lag access to urban areas at all three defined tiers of fixed broadband service speed.

Access to both the fixed terrestrial 25 Mbps/3 Mbps service and the mobile LTE (minimum of 5 Mbps/1 Mbps) is found in areas that have a lower percentage of households living in poverty. These households have higher than average populations and higher per capita incomes, as well as higher median household incomes. The FCC [2018] reported that the U.S. ranked 10th out of 28 countries for download speed, 7th out of 29 for fixed broadband price, and 10th out of 29 for mobile broadband price (using the fixed hedonic price index).

The FCC's short-term connectivity goal is set for 100 Mbps per 1,000 users. Currently, 88% of American schools meet the FCC's short-term connectivity goal. The FCC's long-term connectivity goal of 1 Gbps per 1,000 users is currently met by 22% of school districts. The FCC has *taken additional actions to accelerate deployment, including removing barriers to infrastructure investment, promoting competition in the telecommunications market, and restoring the longstanding bipartisan light-touch regulatory framework for broadband Internet access services* [FCC 2018]. Based on these efforts, the 2018 Broadband Deployment Report concluded that the deployment of broadband service to all Americans is occurring on a reasonable and timely basis. However, improving connectivity and deploying advanced telecommunications capabilities remain top priorities for the FCC. The 2018 Broadband Deployment Report concluded there was still much work to be completed.

3.3.2.2. FCC initiatives

3.3.2.2.1. Bridging the digital divide for all Americans

In the modern United States, the significance of high-speed Internet access (i.e., broadband) cannot be overstated. Life in all spheres, from business to education to civic engagement, depends on this. Certainly, economic growth, nationally as well as regionally, has come to depend upon broadband access. It is a significant problem that there is no high-speed Internet in many locations in the United States. Providing broadband access to all regions, therefore, has become a top FCC priority. FCC initiatives seek to ensure access to all Americans. The FCC has moved on a series of initiatives designed to provide all in the United States with high-speed Internet access. These initiates involve streamlining and modernizing regulations, increasing mobile broadband access, and recognizing the connection between healthcare and broadband access – particularly regarding rural community residents.

3.3.2.2.2. The FCC's 5G FAST Plan

The 5G Fast Plan is among the FCC initiatives. The next generation of wireless connectivity that allows for significantly faster speed and lower latency broadband than at present. To facilitate the expansion of 5G services, the FCC is currently seeking to modernize outdated regulations, update policy on infrastructure, and provide for increasing spectrums in the marketplace.

3.3.2.2.3. Restoring Internet freedom

The FCC's Restoring Internet Freedom Order was implemented in 2017. The goal was to provide Internet access to consumers that would be both faster and less expensive. To facilitate this goal, the Restoring Internet Freedom Order replaced regulations developed in the pre-Internet era – as far back as 1934. The Order also provided for greater transparency and heightened consumer protection.

3.3.2.2.4. Broadcast incentive auction

A very creative FCC initiative to provide mobile broadband service was the Broadcast Incentive Auction. This process involved broadcasters bidding to give up their rights to spectrum usage in return for a percentage of proceeds to be derived from the auction of flexible-use licenses. These flexible-use licenses will provide for enhanced high-speed Internet service. As a result of this process in 2017, USD 19.8 billion was generated in gross revenue and 84 megahertz of low-band spectrum was repurposed for mobile use.

3.3.2.2.5. Telehealth

The FCC recognizes the connection between the provision of effective health care to residents of rural communities and affordable high-speed Internet access. Improved health care outcomes for patients as well as cost savings for patients and providers alike can result from broadband healthcare access. Such benefits, though, cannot be obtained by many lower-income rural residents who lack high-speed connectivity. To connect to crucial health services, the FCC has been working to ensure high-speed access for rural communities.

3.4. Conclusion

Until the mid-point of the last century, most of the population of the United States were classified as residing in rural areas. Today the vast majority of the population reside in non-rural areas. Yet, a plethora of rural communities remain. These communities contribute to the overall economic health of the nation in terms of industries such as agriculture, mining, and others. However, these contributions can come at a heavy cost in terms of lower incomes and adverse health consequences for rural dwellers, particularly when an industry involves activities such as the storage of toxic waste. For all their historic relevance in the United States and the symbolism of rural life exemplified by the scarecrow, rural communities have not kept pace with urban areas in key ways. The idyllic life and almost mythological past embodied by the modern representation of the traditional scarecrow betrays the somewhat complicated reality of the current rural community. In some ways, the scarecrow has moved on to become an integral part of a larger society and economy, but in other ways, this forward movement has been slow and unsteady.

Regarding economic factors, while rural areas can in some cases contribute to the larger national economy, in many instances their local impact is more fragile. For many rural communities, the local economy exhibits higher vulnerability to an economic downturn, compared to economies in urban areas. There is a level of economic diversity across rural communities, with many involved in agriculture, mining, manufacturing, and recreational opportunities, among others. However, compared to populous urban areas, rural communities in the United States tend to be less economically diverse, and more dependent upon a given industry. Despite the economic challenges in rural communities, there is a cause for optimism due to population trends. While populations in rural communities have declined for decades, rural areas have very recently experienced an increase in population. This population growth may bode well for some local rural economies.

Smaller, more fragile, less prosperous economies, however, have in key ways been unable to provide a quality of life compatible with those who live in urban areas. Income can be lower, services can be more limited, food insecurity can be higher, and health concerns can be greater in rural communities; however, all this does not necessarily mean doom. The need for agriculture, a key industry for many rural communities, along with some level of manufacturing will continue to be needed by the larger society. Still, the future for numerous communities within rural America is uncertain.

There is a degree of resiliency exhibited by rural communities, exemplified through the process of linking rural America to the Internet – a process that has moved forward over time. Rural communities, though, lag behind non-rural areas in this regard. While the rural-urban gap may be narrowing, rural communities still lag in terms of high-speed Internet as well as Internet usage. This technological lag feeds into and exacerbates the problems of rural economic life and residents' quality of life. Realization of the crucial importance of technological advancement for rural communities, in particular, broadband access has spurred numerous efforts by government, nonprofits, and public-private partnerships to help close this technological gap. Much of rural resilience in the United States can be seen as the result of government efforts through a wealth of programs to economically and technologically ensure rural viability.

What is at work here is ultimately a realization of the importance of rural communities in the United States. This realization, however, signals a double-edged sword. Rural communities in the United States continue to be meaningful not only to their own citizens but to the nation as a whole, yet many rural areas simply lack the resources necessary for sustained growth and economic and social viability on their own. Except as a popular seasonal decoration, the scarecrow may be of the past. However, there is a collective effort in the United States that the rural communities that gave birth to the scarecrow will live on.

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4

The Polish Manor House – witness to past tradition and culture of small homelands – a case of reconstruction

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Abstract. The article deals with the issue of reconstructing the appearance of the demolished noble manor house and the surrounding garden complex located in the village of Gosprzydowa in Małopolska region. The place belongs to the Wiśnickie Foothills and is situated about 70 km from Kraków. Numerous examples indicate that wooden manor houses often fall into ruin, including those listed by the regional monument conservation authority. With the disappearance of these architectural forms, which are traditional for the Polish cultural landscape, the historic rural landscape undergoes irretrievable changes.

The article attempts to reconstruct and re-create the image of an obsolete aristocratic manor house, no longer existing today, of which no photographs, sketches or drawings survived. The task of reconstructing the appearance of the building was carried out on the basis of archival cartographic sources (map of the Austrian cadastre), historical inventories from the seventeenth and eighteenth centuries, and oral transmission, which, in this case, took the form of a testimony – making it possible to develop a kind of 'composite sketch' from memory. The subject of this research was the manor house building, which was destroyed after WWII. The analysis also included the outbuildings belonging to it, as well as the surrounding garden.

The article presents an analysis of the architectural style of the manor house, characteristics of its location, as well as a description of the garden layout, carried out on the basis of available sources and with the participation of the local community.

Keywords: residential property • social participation and involvement • wooden architecture • cadastral maps • garden layout

4.1. Introduction

4.1.1. General overview

The area of the Polish Carpathian Foothills, the Beskids, and the Tatra Mountains covers about 6% of Poland [Angiel and Pietrzak 2009]. It is a region with a low level of urbanization, and villages with a mosaic of land form its characteristic landscape. In the traditional landscape of the Foothills, the manor house was one of the most important factors shaping the architectural landscape from the seventeenth to the mid-twentieth century [Libicki 2012, Rydel 2012, Raińska 2014]. A typical manor house was a splendid structure, surrounded by carefully selected park greenery, and dominating over the immediate surroundings. The building focused the organization and hierarchy of the space, giving the area a specific noble – agrarian character [Leśniakowska 2007].

The characteristic type of noble residence – the manor house – was surrounded by a complex of auxiliary and farm buildings, necessary for its functioning [Marcinek 2007]. The manor house was a miniature of the entire economy, with most necessities produced on site [Łoziński 2006]. The location of the manor house itself was not accidental [Pietrzak 2005], but it corresponded to the words of Jakub Ponętowski, castellan of Brzeg, included in a seventeenth-century manuscript: Let the nobleman have his own manor, and the manor is ready, government-sized, built to the power, and eager, in a healthy square in view, and built in shape [...] [Marcinek 2007, p. 50]. An example of such a "thoughtful" manor and garden foundation was the manor house in Gosprzydowa [Kaszowski 1995]. It was situated picturesquely on a slope, above the valley of a nameless stream and a pond, and it was the home to the village owners. The lowering of the terrain at a short distance from the manor house opened up a wide view to the whole surrounding area, up to the next valleys and hills overgrown with forest vegetation.

Traditionally, the manor house was located in relation to the four cardinal directions at the so-called 'eleven o'clock placement', meaning that the porch was at that hour in full sun, which ensured that sunlight would reach all rooms during the day [Gloger 1900–1903]. At the end of the nineteenth century, Edmund Jankowski, a gardening theoretician, wrote that the manor house should be located in the best location in terms of view of the most beautiful places in the area, and that it shouldn't be too close to public roads [Jankowski 1898]. The house should be arranged in the following way: the dining room should be located near the kitchen and pantry, the landlord's office not far from the manor house, the driveway on the most accessible side, and the veranda on the most beautiful side, affording the most extensive view [Rozbicka 2003, Markowski and Rydel 2004, Marcinek 2006]. The analyses concerning the manor house in Gosprzydowa confirm that this nineteenth-century description corresponds exactly to the location of the manor house and the layout of its rooms. The place was directly connected with the manor house and garden. Trees and shrubs shielded the manor house and its farm facilities from strong winds. For centuries, a fishpond had been an inseparable element in the manor's surroundings, and the foundation of the owners' prosperity. In the former Polish countryside, the prosperous estate was described by the short phrase 'fish and flour, mushrooms and meadows' [Łoziński 2006, Marcinek 2007]. Apiaries with straw beehives covered with wooden roofs were a common element of the manor farm, as honey was considered a great delicacy [Gloger 1907–1909].

Old court ledgers tell us a lot about the shape of the complex. In the former Poland, they were the basic form of security for the possession, tax assessment, and inheritance cases. To this day, they remain among the most important written sources of importance for research into the history of manors.

The interwar period, the occupation, and the war are the last stages of development of the manor house in Gosprzydowa. World War II and the agricultural reform ended the period of splendour of Polish manors and their neat surroundings. Numerous manor parks were cut down, gardens were destroyed, and no one cared about the buildings. With time, these fell into ruin [Majka 1968].

At the turn of the nineteenth and twentieth centuries, in his sketches and photographs, Zygmunt Gloger depicted wooden cottages, manors, and mills, i.e. features of regional architecture [Gloger 1907–1909]. In the times of the Partitions, in spite of the difficulties, this Polish ethnographer consistently pursued his life's passion for saving the material and spiritual heritage of his homeland – its history, culture and tradition – from oblivion. Today, one can risk a statement that he was ahead of his time by making an inventory of objects that disappeared from the Polish landscape within one century. A small part of these found their way to open-air museums and traditional museums, where they have been preserved. Unfortunately, wood – a material that is not resistant to weathering – was destroyed, humidified or decayed over time. The nobility's manors, often remembering the period of annexation, national uprisings, and warfare [Wojciechowski 1996], disappeared irretrievably from the landscape of Polish towns and villages. Some of the objects were depicted on sketches, paintings, photographs, and postcards – others remained in the inhabitants' memories only.

In the post-war period, during the communist era, thousands of aristocratic residences disappeared irretrievably from the landscape of Polish villages [Majka 1968, Wójcik 1997]. This was undoubtedly influenced by war damages as well as fires, demolitions, or leaving them unattended. Expropriation of the rightful owners typically led to the courtyard buildings being left unattended, which previously served the residential or public utility functions, i.e. as a school, a gatehouse, or a museum.

Noble manors were now meant to serve until the so-called 'technical death' [Fryś et al. 1988]. The authorities of the People's Republic of Poland tried to obliterate the traces of the centuries-old tradition and culture of the landed gentry. The monuments referring to Polish tradition and culture were removed from the landscape and from the people's memory. It is estimated that during the 50 years of the People's Republic of Poland, about 98% of the historical substance of the manor houses was destroyed; often including the surrounding parks and gardens [*Dwór Polski* 2006].

4.1.2. Historical background

The first written references to Gosprzydowa date back to the Middle Ages. At that time, the knightly family of Wielogłowski, of the Stary Koń coat of arms, owned the village. It was probably the Wielogłowski family, coming from Wielogłów near Nowy Sącz, who built a noble manor house in Gosprzydowa. The first mention of the manor comes from the levying of the tithes by the prestigious Kraków Cathedral Chapter in 1215. According to Jan Długosz, who quotes Wincenty Kadłubek, at that time Gosprzydowa had 14 fields, a village hall, an inn, and one manor house, owned by knight Godfryd. The settlement was founded originally under Polish law, and at the turn of the fourteenth and fifteenth centuries it was transferred to German law. In the centuries that followed, the village remained the property of the knightly family of Wielogłowski, of the Stary Koń coat of arms. In the signature of many representatives of this family one can find a nickname 'from Gosprzydowa'. It follows that this was their family nest until the end of the eighteenth century. The last owner of Gosprzydowa from the Wielogłowski family was Barbara, who sold her estate of over one thousand morgen (unit of land measure) together with the Lower and Upper Manors and farm buildings. From 1876 until the time of the parcelling of the manor estate in 1912, the village, together with the entire estate and the manor building, had nine owners. The assets of Gosprzydowa were parcelled out relatively early, in 1912. The so-called 'Resztówka' (Residue), i.e. the lion's share of the Gosprzydowa estate together with the manor buildings, was purchased by a private owner, not of noble origin, who ran a well-functioning farm.

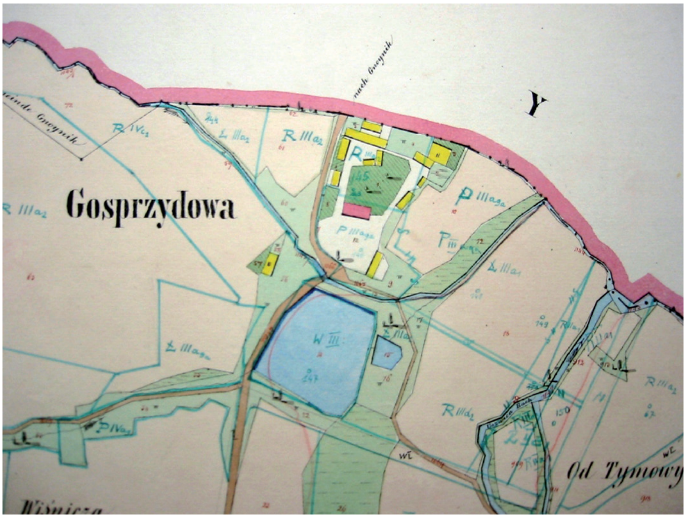
4.1.3. Short description of a manor house in Gosprzydowa

The first information about the shape and form of the manor house in Gosprzydowa and its surrounding buildings is provided by the inventory preserved in old court ledgers. Inventory lists show that traditional spatial solutions used in manor buildings, probably originating in the seventeenth century, could still be traced in its basic layout until the twentieth century [Marcinek 2006]. The oldest inventories found in court archives date back to the end of the sixteenth century. The inventory of 1596 was prepared in Latin (AZC). The first inventory in the Polish language for the manor house in Gosprzydowa was made after the Swedish Deluge, in 1664. In this document one can find information that the owner of the village called Mikołaj Wielogłowski lived in a big house with an orchard. The building was fenced; the fence made of wood and dilapidated. The farm consisted of outbuildings near the manor house and a smaller house called Bodorzyński. Opposite the building there was a bakery, a henhouse, a cowshed, a pantry in the courtyard, a brewery with a chamber, a hog feeder, a spacious barn, and a stable [Prus et al. 2015].

Another inventory preserved in old court ledgers and dating back to 1715 tells us that the estate in Gosprzydowa included the so-called Lower Manor (house number 1), the Ratowszczyzna Manor House, as well as the manor houses in: Bodorzyna, Tymowa and Lewniowa (the names indicate that the latter were located on the border with neighbouring villages). The documents mention that the Lower Manor House had a mill and a brewery. The inventory of the housekeeper's property in the court ledgers was made once again in 1745 after the death of the owner Antoni Wielogłowski. The Lower Manor was already old – as the chronicler literally wrote. The building had a basement and a porch, and the roof was covered with shingles. Judging by the description of the interior, one can conclude that at the time of the description, the manor was abandoned and uninhabited. In the dining room alone, the author of the document counted 20 broken panes. In the yard, from the park side, there was a coach house with a room and a stable. The second stable had a haystack. Both the coach house and the stables were partly covered with shingles and partly with straw. Above the stable there was a granary, with a thatched roof. In the garden there was a 'fenced bee swain' (surrounded by apiary fence). There were barns and sheds, all with thatched roofs. Below the manor house, there was a brewery with shingle roof, while next to the manor house there was a farm belonging to the land clerk. In the manor house, next to the living quarters, there was a bakery, in which there was a quern for milling grain and a groats mortar. The roof was covered with shingles. The manor complex also included a cowshed, a pigsty, a henhouse, a goose pen, a hog feeder, and a stable, all covered with thatched roofs [Prus et al. 2015].

The aristocratic manor house in Gosprzydowa was more than a building; it was a witness to memory and the legacy of past centuries. Among other things, it witnessed mid-nineteenth century events of the Peasant Uprising in Małopolska. The uprising of Galician peasants of 1846 also covered the area of Gosprzydowa, as evidenced by the preserved chronicles [Sieradzki and Wycech 1958]. The aversion to the noble owners, instilled into the rural population by the invaders, resulted, among other things, in the fact that the peasants in Gosprzydowa robbed and destroyed the manor house and several other buildings belonging to the village owner. These events in Gosprzydowa took place (according to direct reports by local chroniclers) on Sunday, 22 February 1846. We read that in the manor house *expensive furniture, underwear, glass, plates with coats of arms, windows were broken, money, and all valuables home furnishings were taken, stolen, dismantled* (...) [Prus 1952]. After such tragic events, the village owners moved to a nearby town and did not return to the house that year. For several weeks after the tragic events, there were no heirs or officials of the Austrian administration in the village. In the autumn months of 1846, the farm buildings belonging to the village estate were set on fire. Aversion to the nobility, thefts, and arson attacks on the manor buildings did not diminish. Indemnification censuses made by Austrian officials in the 1850s noted that several buildings belonging to the village owner were destroyed.

Parish chronicles noted that events with the participation of the peasant population similar to 1846 took place in Gosprzydowa also in 1863, just after the January Uprising, and continued in the years that followed [Prus et al. 2015].



Source: PODGiK Archive in Brzesko

Fig. 4.1. A fragment of the 1848 map of the Austrian cadastre with manor buildings, a garden, a pond and the location of the manor house (brick building, marked in red on the Austrian cadastre maps) Scale 1:2880

In 1876, Gosprzydowa ceased to be the property of the Wielogłowski family, and in the course of the next decades, the manor house had several owners [Prus et al. 2015]. In 1907 brothers Konrad and Zygmunt Christiani Grabieński purchased the estate from Przybyszówka near Rzeszów. They remained the owners of the village until the time of its parcelling in 1912. That year, the manor house with the adjoining plots, ponds and buildings, and a new owner, Samuel Fischler, purchased the so-called 'Remnant'. According to witness accounts, he changed the appearance of the manor house by removing the wooden extension on the northern side. During

WWII, the manor house was the headquarters of the German army. Neglected, it gradually fell into ruin. After the artillery attack in 1944 and the explosion of the ammunition depot in the cellars, the structure of the building was seriously damaged [Prus et al. 2015]. After WWII, the land and the manor house were briefly taken over by the State Treasury. In the coming years they found several buyers, and the land was divided into smaller farms. The new owner demolished the manor house, and today the only evidence of its existence is a 24 m deep well, from which water is still drawn, on the border of Gosprzydowa, Gnojnik and Chronów. It was once located in the cellars of the manor house – now the site of a private garden. The traces of the aristocratic manor house in Gosprzydowa have become blurred, especially since new buildings were built in its former location (albeit in a different spatial arrangement). The location of the former aristocratic residence invariably offers a picturesque view of the pond.

4.2. Material and methods

4.2.1. Study object location

Gosprzydowa is a village in the Małopolska region, in Brzesko county, situated in the central part of Pogórze Wiśnickie (Fig. 4.2).

The research was based on the method of literature queries, spatial analysis of cadastral maps, and handwritten sketches. Despite long and thorough research, no evidence was found in the archives, among private or public collections, that would show the silhouette of the manor house, its architecture, or composition and layout of the garden. What remains is only a trace of the location of the buildings on cadastral maps, thanks to which it was possible to reconstruct the dimensions and shape as well as the arrangement of the farm buildings' complex.

References to the wooden manor house in Gosprzydowa appear in the documents of the State Archives in Kraków, in the documents of canonical visits in the Archive of the Archdiocese of Kraków, as well as in the Inventory Censuses kept in the form of microfilms in the Kraków State Archives on Wawel Hill. The available archival materials, the inventories preserved in the former court ledgers, enriched with interviews with the locals constituted the basis for recreating the appearance of both the manor house itself and its surroundings, i.e. the greenery, connected to the pond and the local landscape. The analysis of the documents reveals the transformations of the manor house taking place in different periods. Starting from the end of the eighteenth century (Josephine cadastre) it is possible to trace the development of the house based on the existing and unchanging elements of land topography. These include, among others, a stream, the layout of the hill, the location of the pond and dyke. House and a garden is a system based on two axes: north-south, and east-west.

The colours on the lithographic prints of Austrian cadastral maps indicate that the manor house in Gosprzydowa was classified as a brick object (Fig. 4.1), which is evidenced by the red colour of the building symbol.

Source: Authors' own study

Fig. 4.2. Location of Gosprzydowa in Małopolska region against the background of the mesoregions

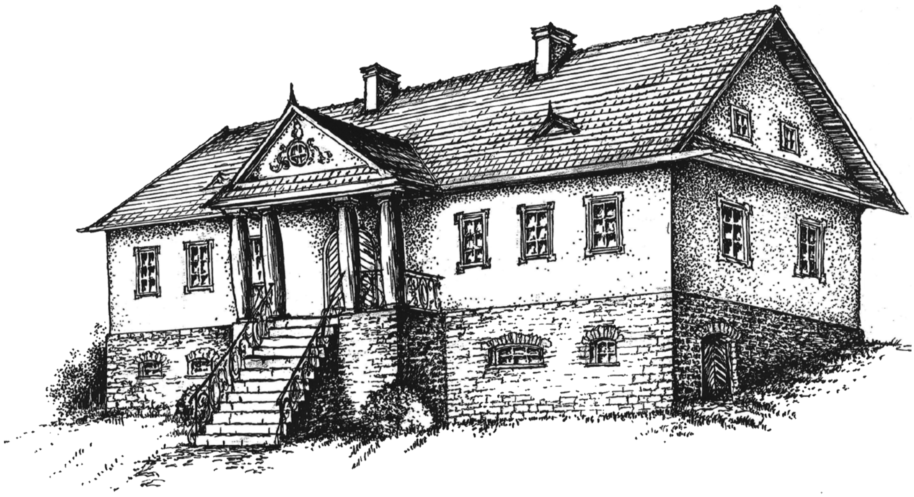
4.3. Results – description of the estate

The building of the manor-garden complex in Gosprzydowa is a wooden mansion built on a stone foundation. Inside the basement there is a well, located directly under the kitchen. The water intake survived the demolition of the manor house.

The one-storey manor house with a residential attic, had a representative, high staircase on the southern side, and an open porch supported by columns.

On the southern side, there was a representative dining room. Access to the building was possible from two sides. It could be described as two routes: official and commercial. The official route led from the pond side (south), through a dyke, and an alleyway of lilacs. The commercial route was on the northern side.

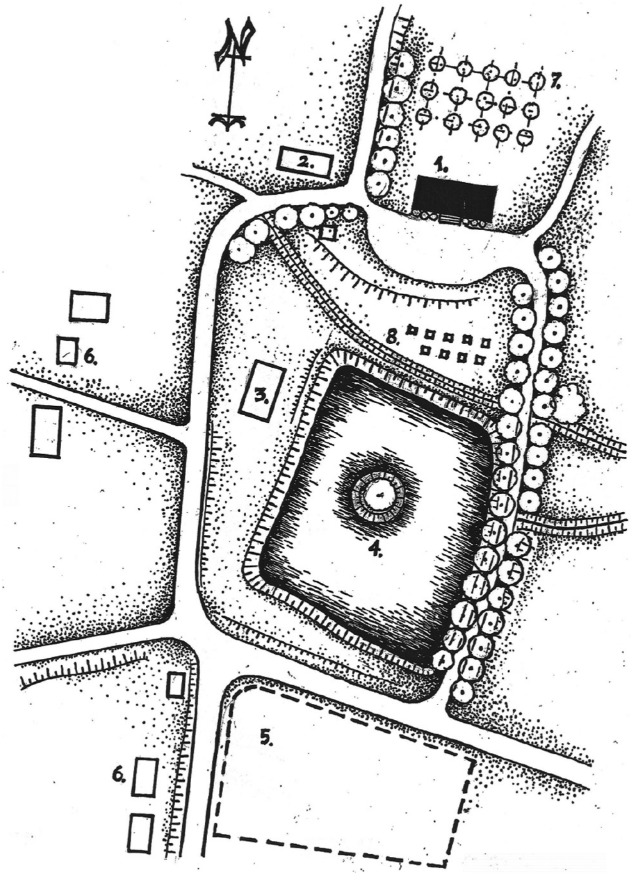
The manor house itself, according to the designers' concept, was situated in the central part of the hill with the southern exhibition, in the middle of its height. The manor house in Gosprzydowa was oriented 'at eleven o'clock', as in the case of typical Polish wooden manor houses.



Drawing: M. Uruszczak

Fig. 4.3. A reconstruction of a wooden manor house in Gosprzydowa (about 1938)

The hill was located north of the pond and the access road. The representative part of the building was oriented to the south. The building of the manor house had a symmetrically situated open porch on its south side, with small columns and high stairs, with a gable roof (Fig. 4.3). In front of the manor house there was an oval driveway with flowerbeds and bushes. The layout of the front part of the garden represented a typical example of similar compositional solutions [Bogdanowski 2000]. There was a view of a nearby pond from here, which was supplied with water from a stream running from the west side along the village boundaries. At that time the pond had an island in the middle with a gazebo on it (Fig. 4.4). From the manor house there was a picturesque view towards the meadows and fields located along the Uszwica river.



Source: Author's own study

Fig. 4.4. Drawing of the manor house in Gosprzydowa and the adjoining garden in a horizontal projection. The markings on the figure: 1 – manor house, 2 – manor's granary, 3 – government building, 4 – pond with island, 5 – brickyard area, 6 – auxiliary buildings, 7 – orchard, 8 – apiary

Until the end of the nineteenth century, on the opposite side of the manor building, there was a wooden annex with rooms for servants. It had an exit towards the orchard and the manor buildings. The garden was surrounded by numerous wooden farm buildings (in the mid-nineteenth century there were 11 of these – see: Fig. 4.1). This was a common division of the manor house area into: an orchard, a farm, meadows and ponds [Marcinek 2006].

4.4. Discussion

The manor house complex in Gosprzydowa had a prerequisite for self-sufficiency. It combined residential and economic functions, in accordance with the tradition of a hard-working life as the basis of the existence and wealth of the owners' family [Bogdanowski 2000]. It is also visible that the manor house in Gosprzydowa was built according to generally accepted patterns, starting from the setting in harmony with the landscape, climate, traditions and customs to the axis and symmetry of the plan [Zachariasz 2002]. It is possible that the 'designer' used the 'Brief Doctrine of the Builder...' published in Kraków in 1659.

In the times of its greatness (eighteenth and early nineteenth century), the manor house in Gosprzydowa embodied an ideal of a rural dwelling, with all the charms of nature, affluence, comfort and order. It enchanted the inhabitants with its location, architectural style, layout of rooms, size, and unique appearance against the background of thatched country cottages [Tłoczek 1985, Pietrzak 2005]. In size, equipment, type of buildings, and their number, it probably resembled the ideal type of the Polish manor house presented by Łoziński [2006].

Source: geoportal2.gov.pl

Fig. 4.5. An aerial photo of the new development on the site of the former manor-garden complex in Gosprzydowa

However, the manor house in Gosprzydowa was not a representative residence of a rich family, but an average, typical noble property. Understandably, the compound of manor buildings and facilities constituted a complex economic system, in which all necessities were produced, starting from food, beer, through blacksmith's products, medicines, clothes, and furniture (www.dworymalopolski).

The pretty, representative driveway to the manor from the pond side, not axially in relation to the manor but along the dyke with lilac avenue from the south-east, made the access road visible from afar. Such an arrangement may result from the former location of an earlier manor, whose existence is confirmed by documents from the fifteenth century. The manor had communication links with the village, church, and neighbouring villages. Today, the road layout is completely changed. The connection with the neighbouring village ceased to exist along the old communication route. In the past, the manor house was the place to which all roads led. After WWII the communication system was redesigned in such a way that the manor house was not included [Krupiński 1989].

4.5. Conclusions

Also today, wooden manor houses continue to fall into ruin. Thanks to the preserved drawings, photographs, archival documents, as well as inventory records and interviews, there is an opportunity to notice and immortalize them. And perhaps, at least in this way, the memory of witnesses to the past cultural identity will survive. They will bear testimony to the Polish national style, the manor house style, which long fulfilled its mission in a society deprived of statehood for about 150 years [Ciołek 1978]. The Polish state existed at that time as a 'fiction of collective identity', which was fervently believed in [Leśniakowska 2006], while architecture reinforced the sense of permanence and lost identity [Marcinek 2006].

In the case of Gosprzydowa, archival inventories preserved in old court ledgers, maps of the Josephine cadastre, and interviews with residents were the bases for an attempt to reconstruct the appearance of the manor house, as well as the layout of the manor complex, garden, pond, and carefully designed greenery, combined with the surrounding landscape [Zachariasz 2004]. This was an opportunity not merely to reconstruct the shape of the manor house itself and the accompanying buildings together with the layout of the garden, but also to preserve the local identity of the place. Perhaps this is the unique chance to capture the details of native rural architecture.

The experience of conservation services, historians or art and architecture, and archaeologists shows that the lack of any traces, mentions, sketches, or notes on the appearance of a particular non-existent monument poses great research difficulties.

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II

Culinary heritage

5

Butcher's legacy of Spiš region

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Abstract. Butchery was one of the most widespread and oldest crafts in Slovakia. Master butchers were among the first to establish their own guilds. This is true also of the Spiš region. The oldest butchers' guilds were created in 1541 by masters in Spišská Nová Ves, and in 1545 in Kežmarok. The organization, rules and hierarchy of the functioning of the butcher's profession in Spiš towns had clear and strict rules aimed at product safety, quality, and honesty of sales. The tradition of butchery production was initially focused on the supply of meat and later developed into the production of meat products. From this tradition, popular meat products such as Spiš frankfurters or Spiš sausages have been kept to this day.

Keywords: butchery • heritage • Spiš frankfurters

5.1. Introduction

Masters butchers were among the first professions to establish their own guilds [Lengová 2008]. This is true of also of the Spiš region (Fig. 5.1). The oldest butchers' guild was created in 1541 by masters in Spišská Nová Ves [Kuruc 1968], and in 1545 in Kežmarok (State Archive[a]). Ten butchers worked in Levoča, and 23 butchers in Kežmarok. In 1579, four butchers worked in Spišská Sobota. In the sixteenth and the beginning of the seventeenth century, towns experienced a great economic boom. This was also reflected in the increase of the number of craftsmen. In 1667, 31 butchers worked in Levoča, and in 1696 their number increased to 34 [Suchý 1974]. In the same year, 33 butchers worked in Kežmarok. After 1735, the towns quickly recovered and the number of inhabitants and craftsmen increased. According to a statement from 1758, 40 butchers worked in Spišská Nová Ves, 25 in Spišská Sobota, 21 in Spišská Belá, 17 in Spišské Podhradie, 12 in Poprad, 10 in Stará Ľubovňa, 9 in Ľubica, 8 in Spišské Vlachy, 5 in Matejovce, 4 in Veľká, 3 in Podolínec, and 2 butchers in Hniezdne [Chalupecký 1996]. In 1770, a butchers' guild in Kežmarok counted 40 masters as registered [Spiesz 1972].

Source: State Archive, Levoča

Fig. 5.1. Map of Spiš region from 1913

As for the religious beliefs of the inhabitants and craftsmen of Spiš towns, they never concealed their sympathy for Luther's teaching and accepted it as their own. The new doctrine has found sympathizers here from the start. Many of Spiš towns had a strong German character. In particular, they maintained trade relations with the German countries. Many students went to Germany to study, and the journeymen were perfecting their craft there.

In the eighteenth century, the majority of inhabitants of Spiš towns declared themselves to be of Evangelical religion of the Augsburg Confession. This applied also to the two largest craft centres in Levoča [Chalupecký 1992] and Kežmarok, where all the members of the butchers' guild were of Evangelical a.c. (as confirmed by the State Archives). The Protestants were predominant also in Spišská Belá [Kollárová 2006] and in the five Upper-Spiš towns. In Spišská Sobota, out of 123 masters there were 104 Protestants and only 9 Catholics [Žifčák 1998]. In Veľká, all butchers were Protestants in 1773 [Malovcová et al. 1998]. However, the counter-reformation hit them hard. In the towns, there were great disputes between Catholics and Protestants. They refused to cooperate and wanted to create separate guilds. In particular, they objected to the first point of the article of the Treaty, in which only the Catholic religion was mentioned, while most of the craftsmen were Evangelical.

Master butchers were among the richest and most respected citizens. Their houses were usually located in town squares or main streets. In addition to their houses, they owned farmhouses, arable land, gardens and farm buildings, granaries, and barns. Butchers were among the largest owners of municipal land and meadows. For example, in Kežmarok, butchers owned the most expensive houses. They were located in the first twelfth (administrative territorial unit in Kežmarok). In the eighteenth century, butcher families included the Toppertzer, Cormides, Maucksch, Lany, and Führer. Butcher's craft manufactories were located at the back of the house or in the yard. This was mainly for security reasons. In the yard, cold storage, stalls, smokehouses, and preparation facilities were located [Botik and Slavkovsky 1995].

The hierarchy in the butcher's guild was significant, and it was divided into a master butcher, a butcher's journeyman, and a butcher's apprentice.

Only those of German descent could become a butcher's apprentice, provided that the candidate's father was neither an executioner, a gravedigger nor a dogcatcher. He had to have guarantors who would pay for his education. The apprenticeship fee was determined by the guilds. The apprentices were between the ages of 14 and 17, living in the master's house, receiving shoes, food and clothing, but no salary for their work. Before they were accepted into training, they had to prove themselves in the so-called trial period of about two weeks. Apprentices in the guilds acted as helpers. They helped housewives around the house and homestead. They cleaned the kitchen, the house, and the manufactory, and served at family meals. They helped the masters and the journeymen, doing auxiliary work. Sons of the masters were often among the apprentices. The guild books show that the masters worked with one, at most two apprentices, if one of the apprentices was the son of a master. Butcher's apprentice trained for two or three years. After completing his apprenticeship, the apprentice was promoted to the journeymen status. Before promotion, he had to get baptized [Weber 1896].

Journeymen had to follow the strict rules of the guild, and they were punished severely for violating those rules. Their behaviour had to be exemplary. As well as master butchers, they were organized into their own journeymen's guild. Their latter, however, was not entirely autonomous. At the head, there was a guild-delegated older master. In their craft, journeymen improved on a wander that lasted 2 years. Butcher's journeymen were organized in Kežmarok into a guild in 1595. The transcript and confirmation of their 19-point articles date to 1760 (State Archives[c], State Archives[d]). The master's son was released from the obligation to wander upon the payment of a fee (State Archives[e]). Journeymen were the busiest of all workers. They received disproportionately low salaries for their work. Their working day lasted, on average, 15 to 16 hours with breaks for breakfast, lunch and dinner. The articles imposed on the journeymen the duty to behave respectably towards the masters and the older journeymen, and prohibited arbitrary punishment of apprentices. At the risk of losing their weekly wages, they were prohibited from celebrating blue Mondays or taking time off work during the week. They always had to be in their lodgings on time, and to announce their departure. On holidays and Sundays, they had to go to church, under penalty. Refusal to help the master was also penalised. They were allowed to walk down the street with bloodied hands or in bloody clothes, barefoot, or with exposed thighs.

A journeyman, who wanted to become a master and thus a member of the guild, had to fulfil several conditions. First of all, he had to demonstrate his professional skills in the master's exam. He had to pay the entrance fee and submit all necessary documents (birth certificate, certificate of apprenticeship, journeyman's certificate). The son of the master paid only half the fee. If the application was approved, he passed a fee for taking the exam. The test took place in the presence of older masters and the guild master, and in some places, the whole guild participated. The sons of the masters received far-reaching concessions. In addition to being protected from paying high fees, they sometimes did not have to take the full test, required of other candidates (State Archives[f]). A journeyman could only become a master in five Upper Spiš towns if his application for admission to the guild was accepted, and after the payment of the fee (State Archives[g]). After long hardship, when the journeyman finally became master, he was not yet guaranteed the full rights, equal to the other masters. He became the youngest master, who was subject to many duties and was limited by various guild regulations. He had to fulfil these duties until a new member was admitted to the guild. For example, for one year since his admission he was not allowed to recruit journeymen or take on apprentices. He had many duties, including those related to calling and serving at masters' meetings. Also, if a member of the guild died, he would be responsible for the vigil and funeral preparations. It was a lot of tasks per one master. Those from richer families were able to avoid this in exchange for a payment.

Only masters had the right to independently produce and place their products on the market. They enjoyed all the benefits of the guild, resulting from its by-laws. Each of them was required to provide scrupulous work and quality products. They could only sell on the market; doorstep trade was banned. Those who broke the ban faced confiscation of meat, which was handed over to the municipal hospital. The town council punished the offender. The new master had to become independent as soon as possible by acquiring a manufactory, therefore, owning a house and a yard was a prerequisite. Most guilds required that their members were of German origin [Baráthová 1990].

Butchers sold their products on weekly markets and fairs. They could visit fairs also in other towns and offer their goods for sale. There was no month in Spiš in which at least one fair would not take place. The butchers had good sales opportunities. The Kežmarok and Levoča masters were able to move freely throughout the province and visit the annual fairs in Prešov and Košice as well as in the thirteen Spiš towns pledged to Poland (1412–1772), and afterwards returned to Hungary. Master butchers from five Upper Spiš towns could also sell their goods at markets and annual fairs in Spišská Nová Ves, and butchers from Spišská Bela traded also in Stará Ľubovňa, Podolínec, and Hniezdne [Vojtas and Szontagh 1971].

The organization, rules and hierarchy of the functioning of the butchers' profession in Spiš towns therefore had clear and strict rules aimed at product safety, quality and fairness of sale. The tradition of butchery production was initially focused on the supply of meat and later developed into the production of meat products. In spite of some changes in the recipe, popular meat products such as Spiš frankfurters or Spiš sausage have been preserved to this day.

5.2. Preserved butcher's heritage

In the interwar period, butchery represented a separate industry in developed countries. It was quick to introduce new processes of mass meat production, modern equipment and technologies. Under the conditions of Slovakia and mostly in Eastern Slovakia, the development of meat processing, as well as the production of smoked meat and other meat products, was limited by the low level of consumption, both in terms of total volume and composition. More than 60% of the working population worked in agriculture. Farmers mostly relied on self-supplied meat. In the interwar Slovakia, meat processing was the activity of several types of companies and trades. In addition to slaughterhouses and companies aimed at the primary processing of slaughter animals, butchery production was concentrated in individual butcheries.

They formed the largest group of production units in the meat and butchery sector [Hallon 1999]. Butchers and smokers belonged to the craft trade branches, whose legal framework was defined by the Trade Act passed in 1924. This trade belonged to traditional and firmly fixed branches in the structure of the production craft. With regard to his irreplaceable role in the production and sale of meat products – the basic food chain for the population, the butcher was a reputable and respected personality of the town and village [Zelenák 1999].

The tradition of Spiš masters, preserved until today, is epitomised Spiš frankfurters. Much has been written about the tradition of Spiš frankfurters' production. Also in the application of SR and CR for registration under Article 8 section 2 of the Council Regulation (EC) No. 509/2006 on traditional specialties guaranteed (2010), the traditional character of Spiš frankfurters' production was documented as a precondition for the registration as a guaranteed traditional specialty.

Their success in the history of production in the Spiš region dates back to the turn of the nineteenth and twentieth centuries [Salamon 2013]. It began at a time when the local butcher Štefan Varsányi in Spišské Podhradie made use of frequent visits of Hungarian nobility to the spectacular fairs under the Spiš Castle. He started selling *Spišské párky – Podracké Viršle* marketing them as a local attraction. His recipe, based on a delicate blend of spices, including sweet and hot peppers, must have been very successful, since after some time he also began to sell these frankfurters in Hungary and Poland. The export of *Spišské párky* was supported, among other things, by the construction of the Košice – Bohumín railway line, incorporating stops at Spišské Vlachy and Spišské Podhradie. The frankfurters were wrapped in special crates in the morning, taken to the first morning train, which went from Spišské Podhradie, to be enjoyed by gourmets from Budapest by noon.

The Spiš frankfurters' recipe, originally called *Podracké Viršle*, was never recorded in writing. Master butchers transferred knowledge from generation to generation. From the historical perspective and the statement of the offspring, such as Igor Varsányi [Nový Čas 2017], and personal statement by the grandson of Karol Grieger – Celestine Grieger, who experienced the production of Spiš frankfurters in the period 1938–1948, as they unanimously report, Spiš frankfurters were made only from pork (lean and fat), salt, high quality red ground pepper (paprika) and water, filled into lamb casings. During the flourishing trade in 1938–1948, Spiš frankfurters were produced by many master butchers in Levoča, Spišské Vlachy, and so on. After 1948, the change of ownership structure was an overriding factor: the expropriation of owners of larger production manufactories was followed by the abolition of approximately 3 thousand small traders – butchers and smokers.

The emerging national enterprises took the knowledge necessary for the production of meat products from former private companies and tradesmen. Already at the time of the first Czechoslovakia, followed by the so-called Slovak state, the town of Prešov, in the close neighbourhood of the Spiš region, became the centre of the butcher's and subsequently the meat industry in eastern Slovakia, and continued as such until the 1990s.

Thus, in the new conditions of national enterprises, new products emerged in the 1960s, from the knowledge of former tradesmen or employees of nationalized companies, which were subsequently transferred into technical economic standards (TES) in Czechoslovakia (Tables 5.1, 5.2, 5.3).

Table 5.1. Selected parameters of the product standard (1954)

	Test norm		
Ministry of Food Industry	**Spišské Párky Quality norm**		**TP 8.9.1954**
	I. Raw Material Requirements		
Recipe			
Needed for 1 tonne of product:			
Pork I (fresh)	600 kg		
Pork II (fresh)	300 kg		
Red pepper sweet	6.25 kg		
Red pepper spicy	6.25 kg		
Salt	20 kg		
Mixing (water)	increase by 210 kg		
Lamb intestines (6.000 m)	17 kg		
Smoking loss			151.5 kg
Chilling loss			50 kg
Manipulation loss			8 kg
	995.5 kg		
	+ 0.5 kg	210 kg	209.5 kg
Final product	1000 kg		
	II. Requirements		
Chemical requirements			
Water	56% ± 4%		
Fat	24% ± 4%		
Sodium chloride	2% ± 0.4%		

Source: Product standard (1954)

Table 5.2. Selected parameters from the quality standard and TES to ČSN 57 7134 (1977)

TES to ČSN 57 7134		
Meat Industry, GRT Bratislava	**Spišské Párky**	**Product number: 794 411 06** **Date: 1.9.1988**
Material norm and technological process		
Needed raw material (in kg) per 1 tonne of final product		
Main raw material salted		
HZV	212 kg	
BCH I	210 kg	
BV without skin	380 kg	
Pig skin	120 kg	
Spices		
Red pepper sweet	6.25 kg	
Red pepper spicy	6.25 kg	
Other additives		
Potable water	210 kg	
Casings		
Lamb intestines Ø 16–24 mm	4800 m	
Chemical requirements		
Water max.	60%	
Fat max.	32%	
Salt	2.2% ± 0.6%	

Source: TES to ČSN 57 7134 (1977)

Throughout the creation and subsequent implementation of the production of Spiš frankfurters as TSG, the uniqueness and tradition of the product was underestimated, when they should be presented by its added value and special approach. In the actual practice, the product has been manufactures as a regular meat product processed in a mass production technology with all the attributes of the present time, including the application of additives (polyphosphates, antioxidants, preservatives in the form of sodium nitrite), and skin emulsion with the application of additives for skin softening (mixture of food acids).

Table 5.3. Selected parameters from TSG Spišské párky (2010)

Spišské Párky (TSG) **Recipe and chemical properties**	
Materials used per of 100 kg of 'Spišské párky' final product:	
• beef with fat content max. 10%	21.2 kg
• pork with fat content max. 10%	21 kg
• pork with fat content max. 50%	38 kg
• pig skin	12 kg
• potable water	21 kg
• nitrite salt mixture (salting of meat)	2.1 kg
• red pepper sweet ground (100 ASTA)	0.62 kg
• red pepper spicy ground	0.62 kg
• polyphosphates (E 450 and E 451)	0.30 kg
• ascorbic acid (E 300)	0.05 kg
• casing lamb intestines	
Chemical properties:	
Fat content: max.	24% ± 4%
Salt content: max.	2% ± 0.4%
Net muscle protein min.	10% of weight

Source: Commission Regulation (EU) No. 159/2011

In addition to the above-mentioned Spiš frankfurters, the Spiš Sausage [1954] was an important product for the region of eastern Slovakia – Spiš, subsequently registered in the Czechoslovak state norm (ČSN) 57 7270. The sausage was among long lasting non thermally treated meat products, of which there were very few on the market, and its popularity in the summer months at the time of agricultural work was very high – due to its shelf-life and palatability. Its recipe was as follows:

- Beef hindquarter (HZV) 32.5%
- Beef forequarter (HPV) 20.0%
- Lean pork (BCH I) 18.5%
- Fatty part of pork 62.0%

The meat was seasoned with a mixture of spices consisting of ground black pepper, sweet pepper, sugar, garlic, and coriander. The beef forequarter meat was ground on a chopper with a resulting grid of 2.5 mm diameter. Other meats were ground on a 3-hole grid. All the meat ingredients were mixed in the mixer with the addition of spices and 1% water and then ground in a cutter with openings of 6 mm diameter. The mixed meat was stuffed into pork thin intestines to form 30 cm long sausages.

The product was smoked and then heat-treated. After cooling, the products were transferred to the drying chamber, where they continued to be smoked with cold smoke. The products were ready for expedition after the water had reached the prescribed value.

The product was characterized by high content of beef, which was in sufficient supply in the region. Today, the production of this traditional product, following the recipe described above, has practically ceased.

Another meat product, which originated in the region in the given period, was *Prešovský kabanos*, classified under the Trade Standard (ON) 57 7224. It was one of the soft meat products subjected to cold storage. In terms of raw material composition, beef was again represented in a high share.

Its recipe was as follows:

- Beef hindquarter 55.8%
- Pork without skin 55.6%

The meat was seasoned with a mixture of spices, consisting of: black ground pepper, ground caraway, sweet pepper, garlic, and spicy red pepper. Beef and pork were minced using a cutter with three-hole grid. Individual meats were salted for 1–3 days. The salted beef was placed in a mixer and the spices mixed in water were added. Then, salted pork was added. The mixed meat raw material was ground on a cutter with a grid of 8 mm diameter, and filled into continuous 22 mm diameter collagen casings in 50 cm strands. The heat treatment consisted in placing the product in a heated smokehouse, where it was baked for 1 ½ to 1 ¾ hours. After baking, the product was quickly cooled with cold water. After cooling, it was ready for distribution. The product with the prescribed recipe is not found in the market at present.

5.3. Conclusions

The region itself had many important meat products, which originated in meat manufactories under the High Tatras. Among them are: *Levočská klobása*, *Sigordská klobása*, *Prešovská saláma*, *Čingovská saláma*, *Tatranská saláma*, *Košická saláma* etc. All these products presented a high content of beef, which was always sufficient due to the mountainous character of the region. Some products have been preserved and continue to be produced today, albeit in modified recipes, which had been significantly influenced by economic factors (reduction in beef content and price), and new technological processes based on the application of additives that were unknown in the heritage trade of master butchers.

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6

Indicators of changes in the diet of the inhabitants of former Galicia

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Abstract. The world around us is subject to constant changes, occurring across many spheres. The progress in agriculture, resulting in greater availability of food, initiated changes in our diet. Some types of food we used to consume before now fell into oblivion. We need to remember that the dishes consumed by the population living in the area are one of the intangible elements of cultural heritage.

The lands located on the northern side of the Carpathian chain constituted the area known as Galicia. In the past, these areas were the poorest provinces of the Austro-Hungarian Monarchy, and the people inhabiting them were exposed to unimaginable poverty. Diversity is an authentic Carpathian tradition. After all, the heritage of many nations and ethnic groups has permeated these mountains for centuries.

The region's location and the climate harsher than in the lowlands also had a detrimental impact. All the inhabitants of the rural settlements of the region, regardless of their nationality, shared a similar diet – that is, a poor one. The food of the population inhabiting these areas always has one main characteristic: these were unsophisticated dishes, easy to prepare. These included pies (flatbreads) prepared directly on the kitchen oven tin (e.g. *moskole* or *proziaki*), as well as dumplings called *haluszki*.

Keywords: cultural indicators • *haluszki* • *moskole* • *proziaki*

6.1. Introduction

The world around us is subject to constant changes, occurring on many levels. We can define milestones marking such events in human history. It could be the fall of the Roman Empire (and later the fall of Constantinople), or the discovery of America. One such milestone was the Industrial Revolution. It took place at the turn of the eighteenth and nineteenth centuries, gave rise to a series of technological, social, and cultural changes, and as a result the face of the world changed dramatically. Then, after the Second World War, technological developments accelerated these changes, and during the last two decades, a vast improvement in information exchange and the development in computer technologies made these changes even more rapid. The on-going development causes the gradual disappearance of professions that are no longer needed, such as a cooper, a blacksmith or a wheelwright.

A significant progress in agriculture is also observed (including so called Green Revolution), resulting in greater availability of food, fewer hands needed for work (mechanization), and a widespread use of fertilizers. In general, food is now available in greater amounts, and also in a much wider range, which is possible thanks to the development of international trade and storage technology. In addition, many types of equipment have appeared to facilitate the preparation and storage of food. This results in changes to our diet. Some types of food we used to consume are now beginning to fall into oblivion, and are replaced by others, which are more convenient to prepare or simply more trendy.

Nevertheless, we should remember that the dishes consumed by the population living in the specific area are among the intangible elements of cultural heritage. As such, they can attract attention of potential culinary tourists, contributing to the development of their regions of origin [Bessière 1998, Świtała-Trybek 2014] by increasing employment in tourism and hospitality industry. Such tourism is beneficial also to local food manufacturers, who can become more recognizable, resulting in increased distribution range of their products.

6.2. Galicia

The lands that are part of today's Poland and Ukraine have a fairly turbulent history behind them. Over the centuries, they belonged to the different states. At the end of the eighteenth century, Poland as a state ceased to exist, and the southern part of its land was annexed by the Austro-Hungarian Monarchy. The lands located on the northern side of the Carpathian chain constituted the province known as Galicia (Kingdom of Galicia and Lodomeria). In the past, these areas were the poorest provinces of the Habsburg state, and the people inhabiting them were exposed to unimaginable poverty. Over the centuries (1772–1918), this province underwent some territorial changes, which were caused by political changes. In 1918, Galicia's area was 78 thousand km^2, and the population grew rapidly. In 1846 it amounted to 4.7 million, in 1880 almost 6 million, and in 1910 over 8 million. It should be noted that during the nineteenth century there was a demographic explosion that caused an increase in the population of Poland – from about 11 million in 1820 to 26 million in 1914 [Davies 2005, Potocki et al. 2012, Hołub 2013, Mizgalska 2014, Wnęk 2015, Franaszek 2016].

Galicia's main problem was dramatic overpopulation. Among other regions of Europe, only England had a similar population density. In agricultural areas it was 78 people per km^2, while in the Polish Kingdom (lands annexed by Russia) it was 57, in Poznań (lands incorporated by Prussia) 39, in White Ruthenia and Lithuania 29, in Germany 33, in France 31. In addition the level of illiteracy was dramatic. These were agricultural areas, very backward and overpopulated, where there was practically no industry. Excess labour was not absorbed by the underdeveloped industry, and the labour market in cities was not much different from the rural one. The unemployment, and then the surplus of wage-employed persons reduced the value of the labour force, and thus deepened the differences between various social strata. Common poverty has led to numerous tensions and social unrest. These areas were inhabited by the three most important ethnic groups: Poles, Ruthenians, and Jews [Davies 2005, Potocki et al. 2012, Hołub 2013, Mizgalska 2014, Wnęk 2015, Franaszek 2016].

We should also note that a large part of the province was occupied by the Carpathian mountain range, which was another factor limiting development and preserving poverty due to the harsh climate and poor soil quality. Galicia was also one of the more neglected and overpopulated provinces of the Empire. Published in 1888 in Lvov, the book 'Misery of Galicia in figures' revealed the catastrophic state of the province's economy. Its authors pointed to the poverty of the Galician villages, which negatively affected the internal market, severely restricting it, which in turn was one of the factors determining the backwardness in industrial production. In fact, until the mid-nineteenth century, the central government was hardly interested in the economic development of this province, and agriculture was recognized as the main area of economic activity of its inhabitants (in the 1870s, 80% of the province's population made a living from agriculture). Agricultural land constituted about 60% of the total area of Galicia. Unfortunately, the Galician village was characterized by low production capacity, low agrotechnical level, and overcrowding, which in turn led to significant unemployment reaching 1.2 million in 1910. This forced many Galicia inhabitants to emigrate [Davies 2005, Taylor 2007, Ślusarek 2010, Mizgalska 2014, Franaszek 2016].

Greater opportunities for the development of non-agricultural economic sphere appeared only in the second half of the nineteenth century, and around this time in Galicia the railway network began to develop. In addition to accelerating economic development, it also performed military functions. One of the most important activities undertaken by the central administration was the enfranchisement of peasants (1848) combined with providing them with land. Alas, the land they obtained was not sufficient for independent subsistence of family farms, because about 50% of those were farms of a size not exceeding 2 hectares. Moreover, the soil of allocated land was not of the best quality; the plots were highly fragmented and often spaced apart. For these reasons, enfranchisement did not solve the main problems of the village, but on the other hand it created the opportunity for free labour to move from the countryside to the cities [Davies 2005, Taylor 2007, Ślusarek 2010, Mizgalska 2014, Franaszek 2016].

6.3. Agriculture in Galicia

Galicia's acquisition of autonomy (in the late 1860s) led to economic recovery. At the end of the nineteenth century, the situation of the Galician village began to improve. This was significantly influenced by those who had emigrated, and after a while began to transfer money back to the family remaining in the homeland. The invested funds resulted in an increase in production over time, and the rising prices of agricultural products further consolidated that. The improvement of living conditions in the countryside has led to a revival of trade and stimulated the development of some branches of industry and financial institutions [Davies 2005, Potocki et al. 2012, Franaszek 2016].

The growing stratification within the rural community in many cases has evolved into social conflicts, including national disputes. In addition, high taxes imposed on residents necessitated the sale of almost all of the acquired agricultural produce. These areas of Austro-Hungarian Monarchy operated in a similar way to colonies. Agricultural overcrowding in the agrarian system led to a decrease in the size of the farms (the collapse of larger farms and the creation of medium-sized ones). As a consequence, it weakened the peasant economy, the effects of which are still visible. In south-eastern Poland, there is the largest number of small farms and the so-called checkerboard pattern of land [Davies 2005, Błąd 2009, Popławski 2009, Ostrowska 2012, Mizgalska 2014].

Table 6.1. Percentage share of main agricultural crops cultivated in Galicia

Years	Cereals	Potatoes	Legumes	Industrial plants	Fodder plants
1876–1885	56.2	9.9	3.5	2.2	27.2
1904–1913	60.7	9.6	2.6	1.1	26.0

Source: Franaszek [2016]

It was not until the 1870s that crop rotation on peasant farms began to be widely applied [Mizgalska 2014]. Despite these numerous errors in cultivation, the level of tillage in Galicia was higher than in Russia-annexed lands of the former Polish Kingdom. The crop structure of Galician agriculture was dominated by cereals, whose share systematically increased (Table 6.1). Cultivation of four basic cereals (wheat, rye, oats and barley) covered 91.5% of the sown area occupied by cereals. In addition, corn, millet and buckwheat were also grown. Of the four basic cereals, oats (33.3%) were the largest, followed by rye (29.1%), wheat (20.6%) and barley (17.1%). A large share of oats was due to its low soil and climate requirements (which was of great importance in the Carpathian Mountains range), and additionally to its use as feed for horses. The importance of oats increased especially in the foothill areas, where the daily average consumption of oat flour by one person exceeded even 1 kg. Oats were used to prepare porridge, borscht, and as a flour admixture when baking bread. Oat production in 1909–1913 was 741 thousand tones. Corn flour was used primarily in the villages of Eastern Galicia [Zamorski 1987, Kuklo et al. 2014, Mizgalska 2014, Wnęk 2015, Franaszek 2016, Musiał 2017, Köhler 2018].

In Galicia, the cultivation of potatoes was very important, because they constituted the basis for feeding the population, especially the poorer strata. They also found use as animal feed, or as a raw material for the distillery industry. It is not easy to establish when potatoes started to be widely cultivated in Galicia. Most likely this was in the 1860s, although some sources point to the beginning of the nineteenth century. In the eighteenth century, the rural population did not want to plant potatoes (although they were already grown in courts) or to eat them for fear of the diseases they allegedly caused [Potocki et al. 2012, Kuklo et al. 2014, Badyna 2015, Franaszek 2016].

Some hints related to the beginning of potato cultivation in the Małopolska region were provided by the study performed on the Krzeszowice-Tenczynek farm in the period 1705–1845. In 1817, attempts were made to plant potatoes in this estate, but the outcome was meagre, with only 48.6% of the initially planted vegetable volume harvested [Zamorski 1987]. However, over time, they gained recognition, and the planting area of potato crops increased. As a result, the produced amounts increased steadily. In the 1880s, the cultivated area was 347 thousand ha, while in the decade preceding the outbreak of World War I, it was over 523,000 ha. The amount of potatoes harvested in Galicia (in thousand tonnes) increased from 3462 (1884–1888) to 5657 (1909–1913) [Potocki et al. 2012, Kuklo et al. 2014, Badyna 2015, Franaszek 2016].

6.4. The food of Galician people

As previously mentioned, in the second half of the nineteenth century, potatoes were the main food product consumed by Galician peasants, independently of their financial status. According to some estimates, the average Galician inhabitant ate 310 kg of potatoes a year, 114 kg of cereals, and only 10 kg of meat. Compared to other nations, the consumption of grain, and especially meat, was extremely modest (Table 6.2) [Potocki et al. 2012, Franaszek 2016].

Table 6.2. Annual food consumption in kg per inhabitant in 1888

	England	Germany	France	Hungary	Galicia
Cereals	217	200	284	182	114
Potatoes	160	300	255	100	310
Meat	50	33	34	24	10

Source: Potocki et al. [2012]

Other than cereals, the basic source of protein for the inhabitants of Galicia were the legumes (peas, beans and broad beans, and less often lentils). The share of meat, dairy products and eggs was relatively low, as these products were often intended for sale. Unfortunately, the spread of potatoes decreased the quality of food consumed by the peasants, because significantly contributed to the reduction of other vegetables in the peasant diet. The predominance of potato turned out particularly dangerous in years when crops were scarce, and during the potato blight, which resulted in a famine. This led to serious social and political consequences [Franaszek 2016]. Other vegetables that played an important part in the Galician peasant menu included cabbage, beetroot, swede, turnip, onion, and garlic. In Western Galicia, the cultivation of swede, also known as snag, was extremely popular [Franaszek 2016].

The milk consumed mostly came from cows, while in foothill areas goat milk was also used, and in the mountains, sheep milk. Annual milk consumption per person was about 180 litres, i.e. less than half a litre per day. Cheeses were made from milk, but their own consumption was relatively low (about 18 kg per year). Most of the cheese production was delivered to cities or sold at fairs. It was similar with butter and eggs (5.3 kg butter and 36 eggs per year, respectively). Flaxseed oil or greaves were used to improve food taste and, of course, its caloric value [Franaszek 2016].

Although it can be seen as an extremely important food ingredient, meat appeared relatively rarely on the plates of an average Galician peasant family (Table 6.2). Of all types of meat, pork was the most consumed, which resulted from the possibility of rapid weight gain of farmed pigs. Cows were bred for manure and also kept as draft animals. In contrast, milk was considered a by-product. Poultry was not consumed very often. The hens provided eggs that could become a commodity for sale, and were also necessary for the preparation of cakes. Fruit and various kinds of spices supplemented the peasant diet. Fruit consumption by peasant families was relatively low. This was the result of a low level of knowledge and a lack of fruit-growing traditions among Galician peasants [Franaszek 2016]. In addition, the rural population acquired food through hunting, fishing, beekeeping, and gathering. We should remember that hunting could be considered poaching, and in Galicia, due to the lack of larger water reservoirs, fishing was little developed. During the famine, wild plants were also used, but the knowledge about them was lost over time. Also plants that are now classed as weeds (e.g. couch grass) were also used for food production [Łuczaj 2007a, 2007b, 2008, 2011, Pokropek 2019].

6.5. Cuisine as a cultural indicator

Diversity is an authentic Carpathian tradition. After all, for centuries the heritage of many nations and ethnic groups has permeated these mountains. Carpathian cuisine is therefore the heir to various culinary traditions, where Armenian, Wallachian, Ruthenian (Lemko and Boyko), Polish, Hungarian, Slovak and Jewish influences overlapped. Very popular among inhabitants of this area were dishes prepared form potatoes, cabbage, groats (mainly buckwheat, millet, pearl barley), as well as milk (cow, sheep or goat), meat, and fruit. All the inhabitants of the rural settlements of this region, regardless of their nationality, had a similar diet, that is to say, a poor diet. Characteristically, the cuisine of the population living in these areas included unsophisticated dishes, which were relatively simple to prepare. These included pancakes prepared directly on the kitchen oven tin (e.g. *moskole*, *proziaki* and others), as well as dumplings called *haluszki*. These dishes were prepared from widely available raw materials, and sometimes they also allowed for the use of inferior quality raw materials. The menus differed primarily in the amount of food, lipid, or milk saturation, and the frequency of the appearance of mean on the plate.

6.5.1. Pies baked on the oven tray

An example of food that is easy to prepare is the so-called shepherd pie (or flatbread) prepared in the southern part of Poland. Shepherd pies were prepared from various types of dark flour, and baked directly on a hot oven tray of an old-fashioned kitchen stove. For poorer people, they were the substitute of bread. Such pastries can be prepared with the use of a leavening agent (yeast, soda) or without it. They can be consumed either hot or cold. Most often they were eaten with butter, sweet or sour milk, cheese, honey, lard, or bacon. In the past, they were frequent food for shepherds grazing herds in mountain pastures – hence their name [Dominik 2017, Królczyk and Tokarska 2019].

A fine example of such a pie (flatbread) could be the *moskol*. This is a typical dish of the Podhale regional cuisine, but the range of its preparation goes far beyond Podhale, because it is also known in Spisz (Spiš) or Gorce mountains. The *moskol* (plural *moskole*) is a thin pie, usually fried without use of fat, the dough prepared from boiled potatoes with a possible addition of oat or barley flour, seasoned with salt. *Moskole* were fried on an oven tray, commonly until the 1960s, often serving as bread. They were taken by the highlanders as a meal for work, where they could be warmed up over the fire after being stuck on a stick. Now they have ceased to be a bread substitute and have become a delicacy. They are served as a regional dish in restaurants in the Podhale region, but now they tend to be fried in a pan, rather than on the hot surface of an oven tray. The basic ingredients for making *moskole* include boiled and mashed potatoes, flour and water, table salt, and sometimes an egg is added. But originally *moskole* were prepared with the use of oats and rye flour, so initially they were rather bony and hard. Potatoes began to be added later, but over time they became an essential ingredient. The dough is formed into pies with a diameter of about 6–10 cm, and a thickness of 1 to 3 cm.

Photo: W. Berski

Fig. 6.1. Homemade flatbread made of wheat flour, yeast leavened, baked directly on the hot surface of an oven tray

There are also versions of purely potato or flour *moskol*, the so-called Spisz *moskol* (in such case baking soda or baking powder is added). Corn flour can be also used in preparation of the Spisz *moskol*. In 2011, *moskole* were added to the list of regional products [Bartosz 2011, Cieślik 2013, Dominik et al. 2017, Głuchowski et al.

2018, Królczyk and Tokarska 2019]. *Moskol* for a long time was used instead of regular bread, which was a luxury product at the time [Szromba-Rysowa 1991, Kruczek and Krauzowicz 2016]. *Moskole*, probably as the basic food, were used during rituals to ensure an abundant harvest (probably this particular rite has pagan roots), and to consecrate food during Easter [Święch and Trebunia-Staszel 2008].

The dish is recognized as a characteristic feature of the Podhale region [Kruczek and Krauzowicz 2016, Charzynski et al. 2017], but unfortunately the word itself is slowly disappearing [Grochola-Szczepanek 2013, Dworska-Kaczmarczyk 2016, Sikora 2017] as are the names of traditional farming tasks or farm objects.

Photo: W. Berski

Fig. 6.2. Homemade *moskol*

It is believed that *moskole* came to Podhale together with Russian prisoners of war during World War I [Cieślik 2013, Głuchowski et al. 2018] and were adopted as an easy-to-prepare dish from basic ingredients. On the other hand, some sources claim that these types of pies were prepared at the turn of the nineteenth and twentieth centuries during the period of great poverty [Szromba-Rysowa 1991, Borys 2008], when they were consumed with *bryndza* (sheep's cheese). According to etymologists, the name *moskal* in Old Polish could be associated with pies because of the inhabitants of the Moscow principality liked to consume *blinis* [Tyrpa 2012]. It should be remembered that the Grand Duchy of Lithuania, which was part of the Polish-Lithuanian Commonwealth, waged wars against the Principality of Moscow from the end of the fifteenth century, where the prisoners could come from. In addition, with the weakening of the Commonwealth's position since the eighteenth century, Russian troops marched through its territory, and Rak [2014] states that the word *moskal* was first recorded in 1534. It was to be an oatmeal pie baked on an oven tray. According to an etymological dictionary, *moskal* could be a word in Old Polish (already recorded in 1543, 1566, 1568) as the name for pie. However, in this author's opinion, the story of Russian prisoners of war is unlikely, since the noun *moskal/moskalik* was already noted in 1845 [Rak 2014]. Therefore, it is possible that the name *moskol* was created by transforming the word *moskal*, which would indicate a much earlier origin of this type of pies – and this seems quite likely, because the dish itself is not a particularly sophisticated one or difficult to prepare. Only with time, as potatoes became more widespread, it began to move away from oatmeal as the main ingredient from which they were made. Such simple flatbreads have been prepared for centuries or rather for millennia. There is evidence that they were already known roughly about 12,000 B.C, i.e. 4000 years before the Neolithic Revolution (First Agriculture Revolution) [Arranz-Otaegui et al. 2018, Barras 2018].

Proziaki (*prozioki*, *prouzioki*, *prołzioki*, *prołozioki* or even *sodziaki*, *łosuchy*) are other example of pies (flatbread) baked directly on a hot oven tray. It is the most recognizable dish from the Podkarpacie region. They are flour pies with the addition of 'proza' (baking soda). They consist of wheat or wheat-rye flour, eggs, sour cream, water, salt and baking soda. They are fried on a tray of a traditional wood-burning tiled kitchen. Their shape can be round (about 6–10 cm in diameter, and about 1.5 cm thick) or quadrangular. They can be modified by adding sugar, buttermilk, cheese or butter to the dough. They can be served with fresh whipped butter, white cheese or marmalade, and usually accompanied with a drink of cold sweet milk. This dish had been consumed for over 150 years, yet the recipe was not formalized, as it was orally passed from generation to generation. For a long time, *proziaki* were playing the role of bread or replacing it, mainly because of the simplicity and speed of preparation. On 10 March 2006, they were added to the list of traditional products of the Podkarpacie region in the category of bakery and confectionery [Woźniczko and Orłowski 2009, Gancarz and Łuszcz 2014, Jakimowicz-Klein 2015, Szepieniec 2016, Mitura 2017, Anonim 2018a].

6.5.2. Haluszki

Haluszki (*hałuski*) are a potato noodles or dumplings (*kluski*), and this is another dish associated with the inhabitants of Podhale. The noodles are made from grated potatoes, flour and salt. Grated potatoes are combined with the so-called 'starch' (a thick deposit formed after pouring 'water' from grated potatoes) and wheat flour. The resulting dough is divided into small portions, using one's fingers, and then thrown in the boiling water. When the dumplings reach the surface, they are strained and served, e.g. with warm milk, bryndza, or with any available fat, e.g. greaves, poured over them. Similar dishes are very popular in Czech and Slovak cuisine, which may indicate that highlander's cuisine was not immune to foreign influence. Due to the method of preparation, they are sometimes also called *kluski scykane* (*scykanie* is a dialect term for separating pieces of dough with a spoon) [Prączko et al. 2005, Cieślik 2013, Jakimowicz-Klein 2015, Kruczek and Krauzowicz 2016, Anonim 2018b]. Today, due to the simplicity of preparation, these noodles are more often made using the Slovak recipe, which applies boiled squeezed potatoes with the addition of more flour and eggs, and this is why they tend to be perceived as a typically Slovak dish [Żydek-Bednarczuk 2015].

6.6. Conclusions

Foods that were once cooked based on the simplicity of their preparation or the availability of ingredients often begin to slowly disappear. This happens for various reasons, even as prosaic as the absence of typical rural kitchen stoves [Dominik et al. 2017, Gaweł 2017, Sołek 2018].

Due to their cultural and natural potential, rural areas can create diversified tourist products, and become an attractive offer under the so-called culinary tourism, testifying to cultural heritage (and cultural distinctiveness).

It seems that in this particular area, regional cuisine, with its diversity and cultural richness, comes first, and it has a lot to offer potential tourists and visitors. Beyond culinary tourism, the possible focus is culinary education, especially if these activities are combined with the use of traditional methods of production.

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7

Traditional flour based dishes in the Carpathian Mountains

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Abstract. Regional highlander cuisine was shaped in harsh climatic conditions and poverty of mountain village people. This meant that the dishes were uniform and consisted of everything that could be produced on a poor farm. The basis was boiled potatoes and various flours meals. Barley, oat, and corn flour were used every day in the cuisine of all Carpathian cultures. Bread was often replaced with *moskol* pancake – baked on a baking tray. Traditional flour dishes are made of some liquid (water or milk) and flour or porridge.

Zamiszka, *bryjka* and *kiselycia* are traditional flour dishes (indicators) of poor people in southern Poland, on the northern slopes of Carpathian Mountains. There are also other flour-based meals in the different parts of the Carpathian, including *mămăligă* (Romania), *kulesz* and *banosz* (Ruthenia/Ukraine), as well as *mačanka* (Slovakia).

These flour dishes are traditional meals based on flour that is cooked in boiling water and typically served with some melted fat or butter. Other ingredients such as pork cracklings, pork fat, mushrooms, salt, herbs, chopped fruits, honey, sugar, and nuts were added to the porridge-like mixture to give it a sweet or salty as well as spicy taste. In some cases, fermentation of raw materials is an additional stage (*kiselycia*) or the sour taste is the result of addition of natural acids (*mačanka*). These dishes are considered as traditional highlander soups, believed to date back to the nineteenth century.

These simple, old dishes are often associated with poor cuisine. Today, however, they are becoming increasingly fashionable, healthy and ecological meals.

Keywords: Carpathian cuisine • traditional flour dishes *zamiszka* • *bryjka* • *mămăligă*

7.1. Introduction

Nations and ethnic groups living in the Carpathian regions have their own culture: original music, different folk costumes and traditions, but above all, a very interesting culinary offer. Regional Carpathian cuisine has been shaped in very difficult economic and climatic conditions. The basic Carpathian cuisine includes everything the farm has produced or bred. Basic raw materials used every day were barley, wheat, oat or corn flour as well as potatoes. Of dairy products, mainly whey and buttermilk have been used. Fermented sheep's milk whey also has a special place in the everyday menu in different countries. It was called *żętyca* (in Poland) *žinčica* (in Slovakia) or *žinčice* (in Czechia). Melted bacon, greaves and sometimes linseed oil were used as spreads. From vegetables, apart from potatoes, cabbage was mainly grown and pickled. Bread was often replaced with pies baked on a baking sheet [Franaszek 2016, Musiał 2017].

7.2. Carpathian Mountains region

The Carpathians are one of the largest mountain ranges in Europe, located in its central part, spanning the territory of Austria, the Czech Republic, Slovakia, Hungary, Poland, Ukraine, Romania and Serbia. They stretch westwards from the Danube gorge near Bratislava to Iron gates – Romanian Porțile de Fier (the Danube gorge near Orszowa). The range is separated from the Alps by the Vienna Valley and from the Sudetes by the Moravian Gate [Witkowski et al. 2003].

The Carpathians are classified as medium-high mountains, with the highest peak of Gerlachovský štít (2,655 m). This range is dominated by hills from 1000 up to 1500 m, while the lowest part is the Dukla Pass (501 m) [Zemanek 2009]. They are divided into Western Carpathians and Southeast Carpathians. The border between them is the Lupkov Pass (640 m). Today's appearance of the Carpathians began to shape from the Miocene era (about 30 million years ago), in reference to the geological structure, neotectonic movements and changing climatic conditions (from dry, hot climate in the Neogene to moderate with several cold periods in the Pleistocene). The heights of the mountain ranges as well as the arrangement and nature of the valleys are associated with neotectonics and varying rock resistance. On the raised parts, traces of former levelling surfaces, which cut off folded structures, have been preserved in places. The geological structure of the Carpathians is quite complicated, however sedimentary rocks dominate – mainly sandstones and shales, but also limestones and dolomites, eruptive rocks, granites, and others [Zemanek 2009].

The decisive factor for human activity on earth is the geographical environment, and above all – the climate, because it exerts a huge impact on the human psyche, and indirectly also on customs, laws and the social system, as well as the possibility of obtaining food. Hence, extremely difficult mountain conditions and the prevailing climate significantly affect human life and activity [Apollo 2014].

The Carpathians are mountains of the temperate climate zone. The Western Carpathians constitute the climate border between colder areas, which are temporarily affected by sea air masses in the north and warmer, with a more continental climate in the south (Great Hungarian Plain). The Eastern Carpathians separate areas with a mild humid climate in the west (Transylvanian Upland) from areas with a dry, continental climate in the east. Due to the varied terrain there is a clearly developed multi-storied climate. The average monthly and yearly temperatures show a decrease of 0.5°C on average for every 100 m of elevation. Precipitation in the Carpathians is lower than in the mountains of Western Europe and depending on the exposure of the ranges and altitude annual totals range from 800 to 1200 mm, while in valleys they do not reach 600 mm. Snow cover lasts over 3 months, and it can remain in the highest ranges throughout the year (snowfall may also occur in summer) [Guzik 2001, Zemanek 2009].

The Carpathians constitute a European water division between the catchment areas of the Baltic Sea and the Black Sea. 10% of the area belongs to the catchment area of the Baltic Sea, the main basin of the upper Vistula (together with its Carpathian tributaries: Soła, Skawa, Raba, Dunajec, Wisłoka and San) and Odra rivers (tributaries: Ostravice and Olza). From the northern part of the Eastern Carpathians, the waters flow into the Black Sea through the Dniester and its tributaries (Strv'yazh, Stryi, Svicha, Lomnytsia and Bystrytsia). The remaining part of the South-Eastern Carpathians and the southern slope of the Western Carpathians belong to the Danube basin (Morava, Váh, Nitra, Hron, Ipeľ rivers); on the southern slope of the Eastern Carpathians begins the largest Carpathian tributary of the Danube – Tisza, fed in the east by Someș, Criș and Mureș; from the Southern Carpathians flowing to the Danube are: Timiș, Jiu, Olt, Arges, Ialomița, and from the Eastern Carpathians – Siret and Prut [Zemanek 2009, Musiał 2017].

7.3. Characteristics of agriculture

The mountainous areas of the Carpathians are characterized by many special features that determine the conditions of agricultural production, non-agricultural forms of economic activity, and the economic development of the region. The clearest and most important features of mountainous lands include high vertical variability and strong undulations. Altitude differences are associated with the occurrence of climatic and plant floors [Starkel et al. 1973]. Studies of the proportions between arable land, grassland and forests show a shift in this proportion in favour of grassland and forests.

Human activity, i.e. customs, social systems, and cuisine in these areas was and still is fairly limited. The degree of difficulty is primarily determined by the so-called thermal sharpness and winter snow [Kondracki 1998], which have an impact not only on biotopes, but above all, on the living conditions of the population, including agriculture. These rates are much lower in the Carpathian Mountains and are characterized by a much higher frequency of snowy winters than in other hilly regions. This significantly delays the growing season and affects the productivity of ecosystems and agriculture. For example, avalanches can be a dangerous economic and agricultural phenomenon [Musiał et al. 2010].

Agriculture and agricultural production in mountainous areas underwent many transformations in Poland over a period of several hundred years. They consisted in colonization by open-air shepherd peoples, mainly from the Balkans or the Southern Carpathians, of open mountain spaces suitable for grazing animals. At that time, the importance of new shepherd areas and those useful for agricultural production, gained through grubbing up of forests, increased, with new open areas inhabited by the population coming from areas north of the Carpathian Mountains. This resulted in the occurrence of almost annual 'pre-harvest' phenomena manifesting in the physical lack of availability of food, including bread (or even potatoes) and the consolidation of so-called Galician poverty (or even misery). This was the reason for – but also the result of – chronic technological backwardness in farms that did not have economic opportunities, nor did they feel the need to switch to more intensive, newer and more efficient technologies or production methods. The food shortage resulting from the overpopulation of villages, and the lack of production or economic opportunities to increase production also caused several repetitive waves of economic emigration [Musiał 2017].

In the past, agriculture was the main area of economic activity and the main source of income for most inhabitants of mountain and foothill areas. To this day, field crops reach the altitude of 1000–1050 m (in Ząb near Zakopane). The average size of private farms in the Polish Carpathians does not exceed 3.5 ha.

During the famine, food shortage caused by the lack of development opportunities for agriculture, the population also consumed wild plants [Łuczaj 2011] as well as the most common, preferably yielding ones. Wild plants were used to prepare a wide range of dishes: soups, bread, flatbreads, stuffing for dumplings, or as spices.

From the beginning of the nineteenth century, the population of the Carpathian Mountains, regardless of their wealth, consumed large quantities of potatoes. Cereal products, and above all bread, were also common food products. The proteins were provided in legumes, and the vitamins in cabbage. Meat, dairy products and eggs were more expensive and were rarely consumed. The basic peasant drink was water, and among alcoholic beverages, vodka was consumed the most, which was largely the result of the long-standing propination coercion. At the turn of the century, the majority of the population lived in a state of permanent malnutrition. The amount and quality of food consumed met slightly more than 50% of the energy demand of a working man.

7.4. Traditional flour-based dishes

The Carpathian regional cuisine was based on raw materials that could be produced on the farm including mainly cereals (barley, corn, oats, etc.) from which flour may be obtained, as well as potatoes or swede.

For centuries, humans have used cereal grain has been as the basic raw material for the production of food and animal feed. The basic component of cereal grains is polysaccharides, occurring mainly in the form of starch (43–65%). In smaller amounts proteins i.e. 8–14% and lipids – 1.5% to 3% (except for oat grain, which contains more than 7% of lipids) can be found in grain. Cereals are also a valuable source of biologically active compounds. This group includes, among others: dietary fibre, phenolic compounds, including phenolic acids and flavonoids, phytoestrogens, phytosterols, tocols, alkylresorcinols, avenantramides or lignans. Most of them have antioxidant properties. Cereal grains also contain numerous microelements, such as: Fe, Se, Cu, Zn, and Mn [Świetlikowska 2008].

The basic energy and structural component of barley grain is starch. 80% of the grain is carbohydrate, including 65% starch. Proteins constitute between 9–25% (enzymatic, structural and storage proteins). Fats are found mainly in the embryo and aleurone layer, their content ranging from 1.9 to 2.6%. Other grains components include rich mineral composition 2.7–3.2% as well as B and E vitamins (from fat) [Kawka and Lemieszek 2017].

Barley proteins are easily digestible, and the bioavailability of its amino acids is higher compared to other cereal species. In barley proteins, the main limiting amino acids are lysine and threonine. In hulled barley protein (also leucine) is known as a limiting compound. There is also a lot of phosphorus, potassium, iron, manganese, magnesium, zinc, silicon and selenium in barley grain. On the other hand, barley grain contains a very low amount of calcium. Additionally, it should be stressed that barley grain contains relatively low amount of anti-nutritional substances [Kawka and Lemieszek 2017].

The chemical composition of rye grain is the result of hereditary features and environmental conditions (soil and climate, as well as fertilization), with the environmental impact being dominant. It was found that differences in total protein, non-protein nitrogen, pentosans and enzymatic activity caused by environmental factors are greater than those caused by varietal factors. Therefore, the range of variation in the content of individual components of rye grain can be very large: carbohydrates – 78–86%, including starch – 56–64% dm; total proteins (N × 5.7) – 9–18% dm; fatty substances – 1.8–2.1% dm; mineral substances – 1.5–2.2% dm; water-soluble substances – 12–18%. Although rye grain generally has a chemical composition similar to that of other cereals, especially wheat, there are significant differences in the content of some ingredients that give it specific characteristics of preventive grain against so-called diseases of civilization – now called chronic non-communicable diseases. Rye is poorer in starch and protein compared to wheat, namely the amount of available carbohydrate is 53.5%, whereas in wheat grain the content of these components is 59.4%. Rye is characterized by a higher content of sugars from the oligosaccharide group, especially fructosans and gluco-fructosans. Rye grains contain 8.65% protein on average, and wheat – 11.5% with a multiplier of N × 5.7. However, the biological value of rye grain is definitely higher than that of wheat proteins. Rye grains contain 30% more lysine. In the case of light flour with a similar extract, these differences deepen in favour of rye flour. In addition, rye has almost 3 times more water-soluble protein, i.e. 3 times more albumin and 2 times more globulins compared to wheat grain. Rye outstrips wheat grain in terms of quantity and quality of dietary fibre. About 16% of total fibre is found in rye grain, compared to about 12% in wheat grain. Based on the example of wholemeal flour, rye exceeds wheat by 25% in total dietary fibre and by 30% in soluble fibre. Dietary fibre is a complex of many ingredients. Non-starch carbohydrates (NSP) predominate in rye grain: pentosans and β-glucans, while cellulose, lignin and pectin are present in smaller amounts [Dzienis 2018].

Sweet corn, both fresh and after heat treatment, has a high nutritional value. It is a vegetable of versatile use in human nutrition. In contemporary health prevention, it is treated as a filling food, adding energy, calming, facilitating concentration, improving brain function and thus facilitating thinking and strengthening the nervous system. An important feature of sweet corn is its lack of gluten, which with an increase in the number of food allergies significantly affects the increase in its consumption. Corn kernel contains large amounts of protein, most vitamins and microelements, and is rich in sugars [Swulińska-Katulska 1996]. Sweet corn as a vegetable is suitable for direct consumption, because the grain at the milk-ripening stage is soft and it contains 74–76% water. In addition, kernels of very sweet varieties have a lot of water-soluble sugars (6–12%). Valuable components of sweet corn kernels include microelements such as selenium, chromium, zinc, copper, nickel, and iron. Particularly noteworthy is selenium, which in combination with vitamin E and β-carotene reduces the metabolic activation of carcinogens and contributes to the detoxification of substances harmful to the human body. Fibre also plays a significant role, as it accelerates intestinal peristalsis, facilitating the passage of digestive tract through the digestive system and reducing cholesterol absorption and blood glucose, and thus acting as an antiatherosclerotic [Watson 1994].

Many different varieties of oats are grown in the world, whose grain composition varies depending on the genotype and growing conditions. The overwhelming majority is husked oats. The husk constitutes on average about 20–36% of the weight of the grain.

Dehulled oat grain contains, compared to grains of other cereals, approximately 2–4 times more fat, 1–1.5 times more protein, 7–8% less carbohydrates. The chemical composition of oats differs significantly from other cereal species; the combination of nutrients it contains is very useful for feeding both healthy and sick people. The nutritional and energy value of oat grain is significant, which is mainly due to the high content of fat, the most energetic component. Oat fat is more easily digestible than other cereals, due to the favourable composition of the fatty acid pool (high proportion of linoleic and α-linolenic acid). In addition, oat oil is a rich source of tocols (tocopherols and tocotrienols), which are compounds of antioxidant properties. Many other polyphenolic compounds that also have antioxidant properties are associated with the fibre structure of oats. Oat protein is richer in essential amino acids than other cereal species, which is why it has greater biological value. In this respect, oats outweigh wheat, corn and even rye (50–80% are globulins). Oat grain is rich in non-starch polysaccharides forming dietary fibre, essential in the daily diet of man for the normal functioning of the body. β-glucans present in oat fibre, especially in nude forms, are assigned a preventive role in combating diseases of civilization, such as atherosclerosis, obesity, diabetes, and colorectal cancer [Butt 2008].

Wheat grain is the basic consumption cereal in Poland, used for the production of bread and other bakery products, as well as pasta and other flour products. Due to the large share in our diet, wheat provides many nutrients, primarily energy, as well as proteins and vitamins, mainly from B group. In industrialized countries, cereal products cover almost 50% of the daily demand for carbohydrates, 30% for protein and up to 60% on B-group vitamins. At the same time, wheat grain is a very important source of bioactive substances with health-promoting properties. These substances are dietary fibre with its main components, such as arabinoxylans, oligosaccharides and lignin, followed by phytates and all remaining lignin, a range of phenolic compounds, including phenolic acids and alkylresorcinols. Due to the high yield and high nutritional value, wheat is also a cereal commonly used for human consumption. Each of the wheat grain uses has different requirements regarding the content of ingredients. Grain with a chemical composition that meets the specific requirements of the industry for which it is a suitable raw material, while maintaining all other beneficial features, becomes a sought-after commodity on the cereal market [Gąsiorowski 2004, Boros 2011].

Potatoes, along with wheat, rice and corn, are the most popular food source for the world's population. They are grown on all continents, most of all in Asia and Europe [Birch et al. 2012, Dzwonkowski 2017].

Potato (*Solanum tuberosum* L.) belongs to the nightshade family (*Solanacae*). The origins of the modern cultivated potato go back nearly 8,000 years to the South

America Andes, on the border between Bolivia and Peru. Domestication of wild potato plants is believed to have started 3,800 m above sea level, around the shores of Lake Titicaca. Now, potatoes are grown in 149 countries in latitudes of 65°N to 50°S, and in altitudes ranging from sea level to 4,000 m, demonstrating the versatility and adaptability of this crop to a variety of environmental conditions [Birch et al. 2012].

The potato has a high nutritional value and low energy. Potato tubers contain on average 77% water, starch up to 16%, 0.5% sugars, approx. 2% protein, over 1% minerals, 2.3% dietary fibre and approx. 0.1% lipids, as well as organic acids., Their nutritional value is primarily due to the chemical composition of tubers, and the main ingredients include: starch, protein rich in exogenous amino acids, dietary fibre, numerous macro elements and microelements, vitamins C, B1, B2, B6, polyphenols, and carotenoids. Consumption of about 200 g of potato covers the daily requirement of an adult human body for vitamin C in about 50%, B6 in 25%, other vitamins in 10–15%, and minerals within the range of 12–30% [Leszczyński 2012, Ezekiel et al. 2013, Zarzecka et al. 2013, Akyol et al. 2016]. The most vitamins and minerals are accumulated in the tuber, under the potato skin; hence the nutritional value depends on the thickness of the preparation method and the time of consumption. In addition, compared to other plant products, due to its low fat content, potato accumulates small amounts of heavy metals, nitrates and residues of plant protection products, and culinary treatment significantly reduces them. Nutritionists believe that the nutritional value of potatoes is so high that it can be the only ingredient in human nutrition for some time without compromising their health [Zarzecka et al. 2013].

Despite the economy and various activities, the Carpathian population generally lived poorly. Their menu was a sign of low wealth. As already mentioned, the basis of food was turnip and swede, then potatoes and cereals, breads and dairy products. Plant products accounted for about 90% of food. Eaten three times a day, meals did not differ much, and warm dishes were only had in the morning and in the evening, as the oven was lit only twice a day [Grzesik et al. 2012].

In the Carpathian region, especially in the northern slopes of the mountains (mainly current Polish territory), the cuisine was based on traditional flour dishes such as *zamiszka*, *bryjka* or *kisełycia*. Although the names of these dishes are not very attractive, they formed the cornerstone of the local diet. Some of them have been known since the early Middle Ages. In the early Middle Ages, various wild plants such as trichinosis, blue trichinosis, and millet were used to prepare these dishes. Also used were currently known cereals, such as: earthen, flatfish or spelled. In addition, multi-row and common barley, seed oats, and rye were grown.

Bryjka

Bryjka is a traditional meal of southern Poland. The term encompasses a number of dishes based on flour that is cooked in boiling water and typically served with some melted fat or butter in the centre. Other ingredients are added to the porridge-like mixture to make it either savoury or sweet, such as pork cracklings, pork fat, mushrooms, salt, herbs, chopped fruits, honey, sugar, and nuts. This dish is associated with the region spanning from Podhale in the west to Beskid Niski in the east. In this region, the meal was considered a traditional highlander soup known since the nineteenth century. The Podhale version of *bryjka* was made by boiling flour in salted water until thick, then rubbing the flour mixture into wooden or earthenware bowls and serving it with pork fat, linseed oil, or lard, and sometimes buttermilk or milk whey. Proto-Polish Slavic tribes had their own version of *bryjka* that consisted of mashed bruised grains such as oats, millet, barley, or wheat, which was consumed either as a sweet dish or a savoury one. This traditional flour dish is also considered a regional specialty of Stary Sącz, where the official name of the humble preparation is *cyr*, but it is generally called *bryjka* or highland pudding. This dish was extremely popular in the foothill and mountain regions. Its regional popularity may be evidenced, inter alia, by the fact that the inhabitants of the village located in the Beskid Sądecki were commonly called *Bryjowiaki* (*bryjka* eaters) [Lis and Lis 2015].

Nowadays, *bryjka* as a regional dish is served in taverns extremely rarely, mainly due to its unattractive appearance. In the past it was a dish eaten every day, not very exquisite or interesting in taste, but providing energy and satisfying hunger. To prepare the dish, grains or groats crushed in mortars were commonly used. Often, coarse, i.e. whole meal flour with a bran fraction was also used.

The essence of preparing *bryjka* consists in one basic activity, which is cooking cereal middlings or flour with water, usually lightly salted, possibly with the addition of lard fat: lard, bacon, linseed oil or butter. It seems that the type of dish that was created in the pot was primarily determined by satisfying specific nutritional needs, not by culinary or taste preferences.

A version of *bryjka,* with relatively loose texture, was prepared with carefully ground grains and sifted especially for children. It was often seasoned with sweet ingredients: honey, fruit or poppy seeds. On the other hand, another version was also commonly known. It was called *kuska* and the main difference was the texture was much thicker than in case of soup like *bryjka*. *Kluska* was a dish rich in carbohydrates, with high caloric value. In both cases i.e. *bryjka* and *kluska*, the energetic value was raised by adding some fat – usually lard. The source of protein was fresh or sour milk, or buttermilk, which accompanied the dish.

The simplest version of *bryjka* was a wholemeal *bryjka* obtained only on the basis of wholemeal flour (from various cereal varieties), water and salt. A variant often found in extremely poor regions was the so-called grandfather's porridge, which was obtained from flour and potatoes [Lis and Lis 2015].

Bryjka or *bryja* does not seem an appetizing dish, which is indicated by its pulpy consistency. However, it is a simple, undemanding dish that can be modified by adding many ingredients.

In addition to *bryja*, another dish prepared in these areas was *zacierka,* made of bolted flour (rye or wheat). The more dense form of that dish was called *zamiszka*. It could also be prepared using sauerkraut juice or whitened using whey – a *polywka*. In some areas, whitened *zacierka* was prepared with some sheep cheese (*bryndza*) and called *mačanka*. A very popular dish in the same group, but served as a dessert, was oatmeal jelly [Grzesik et al. 2012].

Mastyło

Mastyło seems to be a slight variation of *bryjka* that is specific to Lemko people. In fact, *mastyło* is a kind of savoury pudding. There are several different sub regional types of *mastyło* but the canonical version includes a mixture of milk and water in which the flour (usually wheat) is dispersed. The obtained mixture is boiled for several minutes. The dish is usually served with melted butter, browned onion or greaves. In modern recipes some other ingredients may be found, most commonly egg yolk. In the poorest regions, the basic *mastyło* recipe was slightly different, showing the necessity of no-waste cooking. In this case, the base of the dish was water from boiling potatoes. Such liquid was rich in starch, acting as thickener for the pudding. The liquid was mixed together with milk and a small amount of extra flour. The serving of the dish depended on the wealth of the hosts. We should note that the dish was also known in a region further north (the Pogórze region), where it was called *mačanka* – the dish in which some slices of bread may be soaked [Milian-Lewicka 2017].

Kisełycia

In Slavic countries, fermented cereals, such as rye, wheat, oatmeal, or sourdough, are used to make soups. In Poland as well as the western part of Belarus, rye is traditionally used to make a soup that is called *żur*. A modification of *żurek* recipe based on wheat flour instead of rye is known in Poland as *barszcz biały*. On the other hand, fermented oatmeal is a common ingredient in Belarus and in south eastern regions of Poland (Lemkivshchyna inhabited by Lemko people). Throughout the region of the Carpathian Mountains, the fermented wheat or sourdough soups are found – across many countries, including Slovakia (*kyslovka*), and Czechia (*kyselo*) as well as Silesia (*Sauermehlsuppe*) [Milian-Lewicka 2017].

In fact, similar dishes may be also found throughout Eastern Europe – from Russia (*okroshka* made from made with yolks, mustard, *kvass*, cucumbers, greens and roasted veal and ham, served cold with the addition of cream) in the east, Romania and Moldova in the south (*borș* the liquid base for preparing soups that consist of wheat or barley bran, and sometimes sugar beet, fermented in water). A similar manner of food preparation can also be found far in the north (Finnish *hapanvelli* soup made from a rye sourdough starter, potatoes and peas). Some variations of soups based on fermented flour are known in many central and eastern European countries, including Russia and Romania [Thaker and Barton 2012].

In the cuisine of the Polish mountains and foothills, on the other hand, *kisełycia* that is typical of Lemko cuisine is an important traditional dish. There are numerous sub-regional variations of this dish, however, we should note that potatoes were always an integral element of the soup. *Kisełycia* is a traditional dish of the ethnic groups who lived in south-eastern Poland, i.e. Lemkos and Boykos, hence its popularity especially in the Bieszczady Mountains. In the Beskid Niski, *kisełycia* was a daily soup that was eaten in the winter because of the warming properties of oats. Preparation of the dish included, as a first step, sourdough preparation. Oat flakes were placed in the jar (oat flakes can be replaced with oat flour, which increases the health benefits of the *żur*), garlic, bread crust and poured with lukewarm water. The gently curled jar was set aside for three days in a warm place. After receiving the leaven, the soup was cooked on it. The procedure involved boiling water with some spices, with leaven added to this mixture. Then fried onion was added, and the dish was served with potatoes. In a slightly different version, the preparation of the soup could be accelerated, bypassing the stage of long fermentation. In this case, the dish would be prepared on the basis of acid from sauerkraut, which was boiled with water. The oat flour mixed with water was poured into boiling broth. Spices (bay leaf, cumin and garlic) were added and cooked. Linseed oil or greaves were added before serving. The dish was served hot with boiled potatoes in their skins.

Kisełycia played an important role, not only as part of the Lemkos' daily diet. It also had a ritual significance. The Lemkos believed that when prepared for Christmas Eve, a thick consistency, that is, 'the spoon standsing in the soup', testified that 'the cream would be thick', that is, the hosts would be doing well next year. For Christmas Eve, a fast version of *kisełycia* was prepared. The dish was also traditionally served after Lemko funerals as part of the rite called *pohrib* [Kolberg 1974].

The similar soup is also known in the southern slopes of the Carpathians, in Slovakian Šariš region.

The dish is called *machanka* or *mačanka* and is prepared based on broth obtained from dried mushrooms, and acidified by sauerkraut juice. Wheat flour is added to the mixture in order to make a dish with the consistency of a thick soup or sauce. Depending of the subregion or even a village there are many varieties of the dish. We should stress that the Šariš region belongs to the Carpatho-Rusyn Orthodox Christian culture, which is similar to that of the Lemkos in the north. For Christmas Eve, the soup course for Slovaks who are Catholics is called *kapustnica*, a sauerkraut soup with mushrooms, garlic, caraway, paprika, nutmeg, onions and apples or plums for a hint of sweetness. When the soup is served on a non-fasting day, pork and sausage are added to the cooking pot. The Ukrainian dish called *jucha* or *juska*, shares the same origin, although in this version, the soup does not contain any flour. In the eastern part of Slovakia *jucha* is made only from sauerkraut juice mixed with dried peas, plums and, on nonfasting days, can include sausage.

Mămăligă

Unlike the Western Carpathians in the Eastern and Southern Carpathians, the main and most commonly used cereal in Romania is corn, which had been introduced there in the seventeenth century. The most typical and traditional dishes in the region are based on this type cereal. As a result, historically, bread was not as popular as other corn-based dishes. The most iconic one is *mămăligă* – the traditional dish in Romania, Moldova, Ukraine, and Hungary. *Mămăligă* is also known in Bulgarian cuisine as well as among Transylvanian Saxons (medieval settlers from western Germany and the areas of today's Belgium, the Netherlands and Luxembourg). In Poland, *mămăligă* is known as a dish of Galician cuisine, common in Lviv, and currently popular among families from Eastern Małopolska. The origin of *mămăligă* is the Apennine Peninsula, where porridge-like dishes used to be very popular, even in ancient times. Today's Romania was then a part of the Roman Empire, as the Roman province of Dacia. The Romans influenced the region's culture as well as cuisine. One of the evidences for that is *mămăligă,* which is a dish similar to the Italian *polenta*. In fact, contrary to popular belief, the dishes (i.e. *polenta* or *mămăligă*) were also prepared before the sixteenth century (when corn was brought to Europe). Many centuries earlier other types of flour were used to prepare it, including barley, buckwheat, as well as broad beans, chickpeas or beans. The specialty of Italian Alto Adige is *polenta nera* made from buckwheat flour. After cooking it is garnished with anchovies fried in butter and baked after sprinkling with hard cheese. It wasn't until the seventeenth century, after the widespread cultivation of corn in Italy and Romania, that all other types of *polenta* lost their significance, pushed out by corn porridge [Stachowicz 1988].

In the past, *mămăligă* was the basic food among the poor. It was consumed for breakfast as the main course, or as a side dish for dinner. Currently, Romanians eat it as an addition to and with stuffed cabbage (*sarmale*), *tochitură*, a stew combining beef or pork meat and offal with tomato sauce, or alongside fish dishes. Another popular dish is *bulz*, traditionally a *polenta* ball stuffed with cheese that is fried, grilled or baked in the oven and served alongside meat and fried eggs. As an independent dish, it is served with sheep's cheese (*brânză*) or cow's cottage cheese (with cream). *Mămăligă* can also be served in a sweet version, seasoned with sugar [Stachowicz 1988].

When cooked peasant-style and used as a bread substitute, *mămăligă* is supposed to be much thicker than the regular Italian *polenta*, to the point that it can be cut in slices, like bread. When cooked for other purposes, *mămăligă* can be much softer, sometimes almost porridge-like. Because *mămăligă* sticks to metal surfaces, a piece of sewing thread is used to cut it into slices instead of a knife; it can then be eaten held in one's hand, just like bread. *Balmoș* (sometimes spelled *balmuș*) is another *mămăligă*-like traditional Romanian dish, but is more elaborate. Unlike *mămăligă* (where the cornmeal is boiled in water) when making *balmoș* the cornmeal must be boiled in sheep's milk. Other ingredients, such as butter, sour cream, *telemea* (a type of feta cheese), *caș* (a type of fresh curdled ewe cheese without whey, which is sometimes called 'green cheese' in English), *urdă* (a type of curdled cheese obtained by boiling and curdling the whey left from *caș*), etc., are added to the mixture at specific times during the cooking process. It is a specialty dish of old Romanian shepherds, and nowadays very few people still know how to make a proper *balmoș*.

In Ukraine, a very similar dish is called *banush*. *Banush* is a dish whose basic ingredient is corn flour. This is one of the classic dishes of the Hutsul cuisine and the region including the Chornohora range and the Prut and Cheremosh valleys. Cream is an important element in most traditional recipes. The authors of this dish are Hutsul shepherds, who rarely ate meat, because they raised animals primarily for milk. Regardless of the recipe, they therefore mainly added sheep's cheese or other cheeses, which they prepared themselves, to the cooked flour. With a bit of luck, they could also reach for a substitute for animal fat, i.e. greaves and bacon. *Banush* is prepared with cream, cornstarch and selected additives. First, the cream is cooked with a little salt. Then, flour is added. This should be done very slowly: all the time, gently mixing the ingredients so that the mass does not thicken too much. It should have a butter-like texture. When it reaches perfect condition, the dish is transfered onto a plate and sprinkled with the chosen seasoning. Further variation of *banush* is the *tokan*, the classic dish of Khust district shepherds. The recipe has not changed for centuries, and varies only from region to region. While some restaurants and chefs state that *tokan* and *banush* are the same, there is one principal difference respected by the Carpathian locals: *tokan* is much thicker than *banush* and it is cooked on water. Another dish similar to *banosh* is also the Hutsul *kulesh*, in which corn flour is cooked not on cream but on milk and water [Olia 2016].

The basis of *mămăligă* and other such dishes is corn porridge. It has many valuable properties. It supports weight loss, prevents cancer, and is suitable for people on a gluten-free diet. It can be formed into various shapes and combined in any way. Corn porridge served with milk is a great remedy for baby constipation. Cornmeal is a rich source of protein, fibre, and beta-carotene. Due to its high nutritional value and being easily digestible, it is especially recommended for the elderly.

Like any cereal, the one in the corn version is rich in vitamins, minerals and trace elements. It contains, among others, large amounts of magnesium, which is responsible for many processes occurring in the human body. It is one of the most important minerals needed for the proper functioning of the body. First of all, it cares for the proper functioning of the immune and neuromuscular systems. It is involved in the construction of bones and teeth. It reduces the risk of developing hypertension, improves digestion, as well as regulating thyroid function, ischemic heart disease, arrhythmia, asthma, and type 2 diabetes. Potassium is also one of the nutrients found in cornmeal. Thanks to potassium, cells can transmit electrical impulses, but potassium also helps maintain adequate blood pressure and muscle tone. Furthermore, cornmeal is a source of vitamins, including primarily B vitamins (they are responsible for the proper functioning of the nervous system), and vitamin PP (one of the components of enzymes that are involved in the metabolism of sugars, amino acids and fats). The latter vitamin also improves skin blood supply and its nicotinic acid is involved in the synthesis of sex hormones, cortisol, thyroxine, and insulin. *Mămăligă* is often served with sheep's cheese. This type of cheese is also rich in minerals. In combination with cornmeal, they complement each other. Phosphorus and calcium mineralize the bones, thus preventing osteoporosis and osteomalacia in adults and rickets in children. In addition, this product is a valuable source of fat-soluble vitamins, including vitamins A and E, and vitamins C, B6, and B12. It also provides substantial amounts of magnesium, which prevents muscle cramps and helps the body resist stress.

7.5. Conclusion

Regional highlander cuisine was shaped in harsh climatic conditions and poverty. This meant that the dishes were monotonous, and consisted of the ingredients that could be produced on a poor farm. The basic staples were boiled potatoes, but also various flour-based meals. Barley, oat or corn flour was used every day in the Carpathian cuisine. Traditional flour dishes are made of liquid (water or milk) and flour or porridge. These simple, old dishes are often associated with poor cuisine, but today they become increasingly fashionable, as healthy and eco-friendly meals. We should point out that that Carpathian region spans more than 190 thousand square kilometres in eight countries with different cultures, histories, and traditions. Despite this, due to similar climatic conditions and difficult terrain, culinary traditions are extremely similar, and they include simple, easy to prepare dishes based on raw materials available in such difficult conditions. These dishes, despite the variability in composition, usually provide the consumer with a large amount of energy, while providing the body with the necessary nutrients.

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8

Vegetables and vegetable-based dishes in the rural tradition of the Małopolska region

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Abstract. Consumers are increasingly looking for high-quality food that is also distinguished by its unique taste and aroma. Products produced on a small scale by traditional methods meet these criteria. In the foothill and mountainous regions of Małopolska, potatoes, cruciferous vegetables such as cabbage, rutabaga or turnip, legumes, mainly beans and peas, fodder carrots, and beets have been grown for a long time. The list of regional products include, for example, runner beans from the Dunajec Valley of *Piękny Jaś* variety, the 'Polish Eagle Bean', sauerkraut, cucumbers fermented in a well, and dishes made from them, e.g. rutabaga soup, bean pâté with carrots or mushrooms or dumplings with beans.

In the European Union, regional and traditional products are treated as a unique good and unique cultural heritage on a regional, national and continental scale. Such products and national or regional cuisines based on them are also a very important element of tourist promotion of Europe – its individual countries and regions. One of the parameters indicating the quality of traditional products is the nutritional value associated with the content of individual nutrients (e.g. proteins, carbohydrates, fats, vitamins) in food.

Keywords: traditional food • rutabaga • cabbage • cucumber • runner bean

8.1. Introduction

Before World War II, in the foothill and mountainous regions of Małopolska, among the root crops cultivated were mainly potatoes, cabbage, rutabaga, beetroot and fodder carrot, and among industrial plants – flax, hemp, and rapeseed [Szewczyk 2014, Franaszek 2016, Reinfuss-Janusz 2016, Woźny 2016]. Other vegetables were grown on home beds: turnips, parsley, parsnips and cucumbers (especially for fermentation), legumes: peas, broad beans, beans, lentils, vetches, lupines and poppies, which diversified the monotonous diet of the village inhabitants [Wnęk 2009, Franaszek 2016]. On each farm, there was also a garden next to the farm run by the farmer's wife, in which, apart from flowers, peppermint, lovage, wormwood, periwinkle, also vegetables such as onions, garlic, and carrot were grown [Woźny 2016]. In the post-war years, cauliflowers, tomatoes and cucumbers, and sometimes also grapes appeared in the gardens [Grębowiec 2012, Woźny 2016]. The highlanders of the Sącz area also cultivated legume seeds, all of which they called peas, although usually these were beans (whereas peas were called the 'round peas'). Small beans and runner beans were cultivated in interrows in fields with potatoes. After drying and shelling, legumes were kept in bags and soaked before cooking. Sometimes broad beans or beans were sprinkled with bacon or butter, sometimes they were added to sour rye soup, and sometimes to broth [Reinfuss-Janusz 2016]. Legumes were the main source of protein, while cabbage – of vitamins [Franaszek 2016]. The once popular vegetables, such as turnip, rutabaga, and parsnip, are now used on a small scale, usually in regional cuisines [Grębowiec 2012].

Most often, potatoes boiled in water with the addition of herbs, e.g. cumin, were consumed, and water from boiling potatoes was used to make soup. Sometimes potatoes were beaten with the water in which they were cooked. Raw grated potatoes were used to make baked pancakes, as well as lumber and shag noodles with flour [Reinfuss-Janusz 2016]. When potatoes were scarce on the farm, they were replaced with boiled or roasted rutabaga (swede). Peeled and chopped carpels were boiled in water, and then the dish was thickened, by adding flour; sometimes milk was added, too. From shredded rutabaga with the addition of chopped carrots and potatoes, the soup was cooked. The rutabaga cut into slices was baked in a baking tray, while the whole unpeeled swede was baked in ash [Szewczyk 2014, Reinfuss-Janusz 2016].

8.2. Cabbage

One of the most important and common ingredients of the highlanders' food was head cabbage, from which various dishes were cooked. It was grown in large quantities (it constituted up to 60% of vegetable cultivation in this region and, besides potatoes, was the basic food product), and the most popular was the so-called stone head (*Brassica oleracea* var. *capitata*). Cabbage is a vegetable with a very long tradition in Poland, known in many varieties, eaten raw, fermented or cooked. In ancient times, it was called 'a cow in a barrel' because it was treated as a substitute for meat and the basis of many dishes, including an Old Polish dish of sauerkraut-and-meat stew called *bigos* [Grębowiec 2012].

Fermented vegetables, mainly cabbage and cucumber, as well as beetroot are very popular in Central European culture [Zaręba and Ziarno 2011]. Fruit and vegetable fermentation is one of the basic methods of food processing. It increases the product's shelf life, and results in the generation of processed food products, differing in organoleptic characteristics from the raw material used in their production. Fermentation involves the fermentative transformation of simple sugars into lactic acid by microorganisms – lactic acid bacteria. These bacteria play the role of natural food preservatives [Chlebowska-Śmigiel and Gniewosz 2013]. Most plant-based raw materials are susceptible to souring; the only condition is the appropriate content of saccharides. Lactic acid lowers the pH of the environment and inhibits the growth of many microbes that are undesirable in food. It is assumed that a decrease in pH to a value below 4.2 ensures the permanent preservation of the plant raw material. The conditions in which the lactic fermentation process of raw materials of plant origin is carried out are a key element affecting the quality of the product obtained. Fermentation temperature, salt content in silage and composition of the raw material subjected to fermentation affect the fermentation process and the micro flora present in the final product. The optimum temperature in the early days of fermentation is 20–22°C, and in order to ensure high-quality product, the temperature should be gradually lowered in subsequent stages of the process [Jarczyk and Płocharski 2010, Ratajczak et al. 2017].

Cabbage was fermented in large barrels with a capacity of up to 150 litres, so that it lasts for the whole year, until the next harvest. The cabbage was shredded, although it happened that small heads of cabbage with cut depths were sometimes inserted whole. In addition to salt, spices and carrots were added, and sometimes small sour apples as well. Sauerkraut was most often cooked by adding flour or a roux. Sterile (fat-free) cabbage dishes were eaten during fasting periods. Cabbage with meat – pork, goose, sheep or greaves – was a festive dish. Using sauerkraut juice, the soup was cooked, which was eaten with boiled potatoes or dumplings, or without additions. Other dishes were also cooked, so-called sourdough soup or cabbage soup, in which sauerkraut was added to boiling water. After boiling the cabbage until soft, boiled potatoes were added to it, sometimes the dish was whitened with cream, browned with oil or greaves. Cabbage with peas (beans) was often prepared. Overcooked beans made the cabbage smooth, and the dish became more filling. Cabbage with peas or mushrooms was also one of the Christmas Eve dishes [Zieliński 2014, Franaszek 2016, Reinfuss-Janusz 2016, Woźny 2016].

White cabbage is a very popular vegetable in Poland, consumed in various forms, including after acidification. It plays an important dietary role due to the high content of vitamin C (25–50 mg), organic acids, glucosinolates, protein with a beneficial composition of amino acids and dietary fibre [Gajewski and Radzanowska 2004, Krochmal-Marczak et al. 2017]. The energy value of cabbage is not high because 100 g of fresh weight provides 124 kJ (30 kcal), but the nutritional value is high. It is a rich source of mineral compounds, i.e. sodium (6–19 mg), potassium (177–285 mg), calcium (17–76 mg), iron (0.3 mg), and magnesium (13 mg). The most valuable is fresh white cabbage consumed raw, because when cooked, it loses a lot of vitamins, especially vitamin C [Tynek and Papiernik 2005]. In contrast, well-acidified cabbage retains vitamin C in 80–90% [Szwejda-Grzybowska 2011]. It contains mustard oils, which contain sulphur. These oils have a positive effect on appetite, especially during the early spring. Many scientific studies also note that the systematic consumption of dishes prepared on the basis of cruciferous vegetables (*Brassicaceae*), including white cabbage, can be a significant element in cancer chemoprevention, especially in people at risk of breast, colorectal, and lung cancer [Orłowski 2000, Kusznierewicz et al. 2008]. After acidification, the cabbage retains its nutritional value and acquires its characteristic taste characteristics. During the fermentation, new ingredients appear, e.g. acetylcholine [Jarczyk and Płocharski 2010].

8.3. Rutabaga

Traditional dishes, in addition to dishes such as mushrooms with potatoes, noodles with poppy seeds, dumplings with cabbage and mushrooms, dumplings with cheese, dumplings with apples, soup with dried apples, pears, and plums, also included rutabaga with potatoes and vegetables, rutabaga cooked with milk or baked in a baking tray [Kroch 2016].

Rutabaga (*Brassica napus* var. *napobrassica*) is now a less known and partly forgotten vegetable in Poland, but it used to be more popular – that is, before potatoes appeared in the crop. Rutabaga is tasty; besides, it can be prepared in a variety of ways. Not only the demonstrated nutritional value, including the high content of bioactive ingredients and taste values is in favour of this species. It is also recommended by the ease of cultivation, high yielding and the possibility of cultivating as aftercrop, which supports the processing campaign in this very seasonal branch of the food industry, that is, growing fruit and vegetables. It is suitable for storage, just like potatoes and carrots. Traditionally, rutabaga was also sliced, dried and stored in bags in the attic [Góral 2012, Köhler 2014, Franaszek 2016].

Rutabaga can be a great addition to many dishes, for instance, replacing potatoes. It is also possible to prepare soup based on rutabaga. Potatoes with rutabaga and with the addition of allspice should be boiled, crushed by adding a pinch of salt, nutmeg, and a little butter. Rutabaga can also be a served with dinner or as a snack, with an addition of horseradish salad and green parsley. You can also prepare crispy pancakes (http://sekrety-zdrowia.org/pyszne-potawy-brukwi/) from the cob with added yogurt and fresh herbs.

An interesting idea for dinner may also be a bowl of rutabaga soup, with the addition of root vegetables: carrots, parsley, pearl beans, flour, sometimes potatoes cooked with the addition of milk, cream or butter. Such a soup is on the list of traditional products of the Małopolska region [MRiRW 2020]. Another dish is swede soup cooked with groats and a piece of smoked bacon [Horwath 2020].

Brassica vegetables are vegetables that have a rich composition of nutrients. The low content of sugars and fats makes these vegetables low-calorie products, yet rich in micro- and macro elements as well as dietary fibre [Sikorska-Zimny 2010, Campbell et al. 2012]. Vegetables from the *Brassicaceae* group contain significant vitamins A, C, K, and folic acid, in amounts that cover the recommended daily intake of the average person, as well as significant amounts of vitamin B_6, niacin, and riboflavin. Among the minerals, we can distinguish: potassium, iron, zinc and calcium, there are also trace amounts of selenium and iodine [Campbell et al. 2012]. It is also a rich source of biologically active substances that are a valuable tool of chemoprevention, containing phytochemical compounds, i.e. plant polyphenols, carotenoids, dietary fibre, glucosinolates, vitamins (C, E, D, foliates) and minerals (calcium, selenium) [Szwejda-Grzybowska 2011].

Rutabaga is very filling, but low in calories, as it provides 29 kcal (123 kJ) in 100 g of fresh product. The tuber contains large amounts of water, 88.9–90.0 g in 100 g of edible parts, in addition to 3.5–5.7 g carbohydrates, 0.9–1.2 g protein, 0.16 g fat, 1.4–2.9 g dietary fibre, 0.2 g starch. Besides, 100 g of fresh product contains 0.77 mg of minerals, 200–227 mg of potassium, 40–55 mg of calcium, 31 mg of phosphorus, 11 mg of magnesium, 5–15 mg of sodium, 400–500 μg of iron, 94 μg of zinc and insignificant amounts of copper, manganese, fluorine, nickel, iodine, and boron. Of the vitamins, it is rich in vitamin C, ranging between 30–44 mg, and niacin in the amount of 800–850 μg, as well as smaller amounts of vitamin B_1 (50 μg), B_2 (58 μg) and B_6 200 μg, and 99 μg of beta-carotene [Souci et al. 2000, Puupponen-Pimiä et al. 2003, Baardseth et al. 2010, Campbell et al. 2012]. Root vegetables, like turnips and carrots, have a high content of 41−47% exogenous amino acids, i.e. lysine, leucine, isoleucine, threonine, and glutamic acid [Prośba-Białczyk 1995].

The content of polyphenols, antioxidant compounds in vegetables depends on many factors, such as species, variety, growing conditions or harvesting date [Podsędek 2007]. The total polyphenol content in the cob was 42 mg/100 g fresh weight and 320 mg/100 g dry matter [Puupponen-Pimiä et al. 2003, Baardseth et al. 2010]. Antioxidant activity of fresh swede against DPPH was 1.87 μmol trolox/g fresh weight, therefore, it was lower than in cauliflowers and higher than in cabbage [Puupponen-Pimiä et al. 2003, Baardseth et al. 2010].

The national register of varieties of crop species [COBORU 2020] contains three types of swede: *Kaszubska*, *Nadmorska* and *Saba*. Cruciferous plants, including rutabaga, contain active pharmacological substances used in nutrition and human treatment, i.e. phytochemicals: phenols, vitamins, minerals and glucosinolates, which largely account for the specific taste and smell of cruciferous plants and dishes prepared from them [Patyra et al. 2017]. They also contain phenolic compounds that affect the taste and colour of vegetables.

In epidemiological and experimental studies, it was shown that the consumption of vegetables from this group has a significant impact on reducing the risk of cancer [Śmiechowska et al. 2008, Szwejda-Grzybowska 2011, Cieślik et al. 2017]. The beneficial effects of *Brassica* genus vegetables on human health are also attributed to the antioxidant compounds they contain.

Cruciferous vegetables contain glucosinolates, secondary metabolites of plants whose degradation products, isothiocyanates, show significant toxicity to some of pathogenic fungi, viruses, bacteria, insects, higher plants and play a role in allelopathic interactions [Oleszek 1995, Piekarska et al. 2010]. Increased content can be observed in plants growing in natural conditions that do not require the use of synthetic plant protection products.

Breakdown products of glucosinolates, isothiocyanates, and aldols show high activity, important in the chemoprevention of tumors (inhibition of carcinogenesis). There are many mechanisms explaining the anti-cancer properties of isothiocyanates. The mechanism based on inhibition of metabolism of carcinogenic compounds by cytochrome P450 (in phase I) and stimulation of phase II detoxification enzymes is best known [Vig et al. 2009]. Glucosinolates additionally have antiviral and antibacterial activity, and also protect the body against reactive oxygen species [Szwejda-Grzybowska 2011]. The products of enzymatic hydrolysis of glucosinolates are biologically active compounds, i.e. goitrine, isothiocyanates and thiocyanates, which are degraded to simpler forms under the influence of the enzyme myrosinase (thioglucosidase) active as a result of cell damage, e.g. during mechanical processing of food, the action of microorganisms or insects, and the action of intestinal microflora living in the digestive tract. The presence of isothiocyanates is responsible for the specific taste and smell of cruciferous plants commonly used as vegetables or spices, e.g. cabbage, radish or mustard. Isothiocyanates are immunity-building factors with anti-cancer properties. Research on wild plants and theoretical calculations of the content of these compounds in cruciferous plants indicate that their level is sufficient to inhibit pathogen growth. Plants respond to damage by increased glucosinolate synthesis as the natural defense system acting through an indole-based phytoalexin is activated, and glucosinolates are by-products of phytoalexin synthesis or their substrates [Oleszek 1995]. This is mainly due to the presence of two isothiocyanates: sulforaphane (1-isothiocyanate-4-methyl-sulfoninyl-butane) and iberine (1-isothiocyanato-3-methyl-sulfininyl-propane), found mainly in broccoli, white cabbage, cauliflower, Brussels sprouts, and kale [Sarikamis et al. 2008, 2009]. Hydrolyzed products of glucosinolate breakdown before digestion can be absorbed in the small intestine, and hydrolyzed under the influence of microflora in the colon, and they are partially absorbed in the large intestine [Robinson 2002]. It has also been proven that including cruciferous vegetables in the diet at least 1–3 times a week leads to a reduced risk of prostate cancer [Keck and Finley 2004].

Glucosinolates, together with the decomposing enzyme myrosinase (β-thioglucosidase, thioglucoside glucohydrolase EC 3.2.3.1), constitute the plant's defense system against herbivores and pathogens [Rask et al. 2000]. Hydrolysis of glucosinolate S-glycosidic bond occurs when the plant cell is damaged, e.g. during cutting or chewing. Then, D-glucose, sulfate and aglycone are released, undergoing further non-enzymatic transformations. It has been shown that factors such as lack of some nutrients in the medium, blue light, salicylic and abscisic acid, and methyl jasmonate may affect myrosinase activity [Hosegawa et al. 2000].

Glucosinolates are compounds with high chemical stability, i.e. stable and resistant to high temperatures. As a result of enzymatic hydrolysis of glucosinolates, biologically active isothiocyanates and indoles are formed. The above hydrolysis is catalyzed by the enzyme myrosinase, which occurs in myosin cells. The enzyme is present in cruciferous tissue and is released only during the raw material pre-treatment (cutting, crushing), as well as thermal treatment, e.g. during cooking. These cells are located in conductive beams and thanks to such location they potentially constitute an effective defense system against pathogens that feed on plant juice, as well as allow coordination of the synthesis of defense compounds throughout the plant [Andreasson et al. 2001]. As the content of glucosinolates and their derivatives increases, the susceptibility of plants to pest attacks decreases [Kliebenstein 2014]. Myrosinase is inactivated at 90°C, and the glucosinolate degradation process varies depending on the pH of the environment [Śmiechowska et al. 2008]. Heat treatment of swede causes inactivation of myrosinase after just 10 minutes of boiling, thereby reducing the bioavailability of isothiocyanates [Higdon et al. 2007]. Boiling in water for more than 10 minutes causes loss of vitamin C and glucosinolates [Vallejo et al. 2002, Baardseth et al. 2010].

Excessive consumption of vegetables containing glucosinolates, in addition to positive effects, may be the cause of goitrogenic and even mutagenic effects [Higdon et al. 2007, Śmiechowska et al. 2008]. Too many cruciferous vegetables in the diet can cause two-stage hypothyroidism. At the first stage, it contributes to a decrease in thyroid secretory activity by inhibiting the synthesis of thyroxine. The consequence of this stage is a decrease in the levels of triiodothyronine and tetraiodothyronine in the blood. At the second stage, there is an increase in thyrotropic activity of the pituitary gland, which causes thyroid mass overgrowth. The use of a mixed diet reduces the risk of negative effects associated with excessive consumption of cruciferous vegetables [Szwejda-Grzybowska 2011].

8.4. Cucumber

Compared to other vegetables, cucumber (*Cucumis sativus* L. has a high water content, 93.9–95.6 g in 100 g of fresh weight, placing this fruit among plants with low storage stability in the raw state. Hence, cucumbers are processed, mainly fermented or pickled [Jarczyk and Płocharski 2010, Migut et al. 2018a, b]. Valuable ingredients of cucumbers are reducing sugars whose content in fresh cucumbers is in the range of 3.24–4.32 g/100 g, and vitamin C – 9÷11 mg/100 g. Pickling enriches cucumbers, among others, in lactic acid or vitamins B_1, B_2, B_3, B_6. In well-picked cucumbers, the lactic acid content can reach up to 1.76 g lactic acid in 100 g of fresh weight. This affects the pH of the products, which can reach a value of 3.2–3.9 [Migut et al. 2018a, b]. After pickling, cucumbers retain 2 to 8 mg of ascorbic acid in 100 g. The list of traditional products of the Ministry of Agriculture and Rural Development includes cucumbers pickled in a well. For fermentation, cucumbers with the addition of horseradish, dill, garlic, and salt, are put into a barrel, water poured over them, and the barrel very tightly closed. The filled barrel is immersed in a well so that the cucumbers have a constant temperature of pickling. Pickled in this way, they acquire a specific taste and aroma, because the well stabilizes and delays the process of pickling, which affects their quality and taste [MRiRW 2020].

8.5. *Piękny Jaś* runner bean from the Dunajec Valley

Runner bean (*Phaseolus coccineus* L.) was introduced to Europe from Central America. It is a perennial species, but in Polish climatic conditions (transitional, temperate climate) it exhibits an annual cycle of growth because its tuberous root system does not survive cold winters [Łabuda 2010]. The tradition of growing runner bean on Polish land goes back to the sixteenth century when it was initially grown as an ornamental and medicinal plant in monastery gardens. In the twentieth century, for many years one cultivar, called *Piękny Jaś* dominated the Polish market, but in the less agriculturally advanced southern and south-eastern regions numerous landraces were commonly cultivated by farmers [Łabuda 2010]. Runner bean is traditionally grown for its dry seeds. Consumers in Poland are accustomed to the specific taste of the large seeds of the beans. In Polish cuisine, dry bean seeds are used for making soups, casseroles, salads, appetizers, and a variety of hot main course dishes. Climbing forms of green beans are often grown in home gardens on supports or fences as an ornamental vine plant due to its beautiful inflorescences with white or red flowers [Boczkowska et al. 2012].

Piękny Jaś from the Dunajec Valley is the name of a white variety of multiflorous beans, which in 2006 was included in the list of traditional products by the Ministry of Agriculture and Rural Development. Seeds of this bean variety belong to the largest among other multiflorous bean species. They have a slightly sweet taste, uniformly kidney shape, whitish colour, thin skin, and delicate structure. *Piękny Jaś* variety is grown on plantations located in 11 municipalities across the Dunajec valley – in low areas, on extremely fertile river meadows. The Dunajec Valley has environmental conditions extremely favorable for this bean variety, as there are no sharp temperature fluctuations, and the crops are not exposed to strong gusts of wind [Gwóźdź 2019]. Climatic conditions plus age-old farming experience are a source of unique taste. *Piękny Jaś* is a 'magic' bean, from many wonders are conjured, including: bean soup, pâtés, dumplings with bean stuffing, pies, and cakes, as well as sausage and high-grade liquor [Gwóźdź 2019, Prokocka et al. 2020].

Prime soil and climate conditions of the Dunajec valley, guarantee a favourable, even, and healthy seed yield, in combination with great taste value of this valuable bean variety. This is why the farmers, despite the emergence of new whipped varieties of multiflorous beans, continue to grow the local *Piękny Jaś* bean. Wind is also an important factor in growing tall, stalky forms. Bean plantations in this area are located relatively low, often at a short distance from the river. Thanks to the location, the fields are sheltered from the wind, and morning fogs in spring and autumn limit the rapid temperature change between day and night. The long tradition of growing *Piękny Jaś* beans, excellent soil and climate conditions of the Dunajec valley, location of the plantation, reliable crop of healthy seeds, recommendations of nutritionists to consume legume seeds, and the use of *Piękny Jaś* bean seeds in regional culinary art have contributed to listing this valuable local variety among traditional products [MRiRW 2020]. *Piękny Jaś* plantations have already permanently entered the landscape of the Dunajec Valley in the Małopolska region, and beans in various forms are an important element of regional cuisine. Bean promotion festivals are also organized, such as 'Bean Festival' and 'Bean Harvest'.

These are beans of large seeds (thousand seed mass 890−3000 g). In 100 g of fresh weight, mature seeds of this variety contain: 12.9 g of water, 15.8 g of protein, 52.2 g of starch, 3 g of ash, 13.7 g of dietary fibre, including 1.76 g of soluble fraction, and in addition, flatulence causing galactooligosacharides: raffinose 0.5−0.6 g and stachyose 2.0−3.0 g [Kosson 1988, 1995, Krupa and Soral-Śmietana 2003]. Of minerals, magnesium content is particularly high. The beans are a source of other important compounds, such as polyphenols, sterols, tocopherols and polyunsaturated fatty acids, which can be found in significant amounts, even in heat-treated products [Umeda et al. 2018, Wołosiak et al. 2018].

A number of locally known dishes are prepared from beans of this variety, such as bean and potato chops (made of *Piękny Jaś* beans from the Dunajec Valley, potatoes, onions, butter, egg, potato flour, parsley, bread crumbs, walnuts); golden sticks from beans and cheese on caramelized beetroot flakes with a hist of cherry-basil (homemade Korycin cheese, wheat flour, egg, breadcrumbs, rice oil, chili, salt, pepper), or beans with lamb in pepper sauce [MRiRW 2014].

8.6. Conclusions

One of the parameters characterizing the quality of traditional products is the nutritional value associated with the content of individual nutrients (e.g. proteins, carbohydrates, fats, vitamins) in food.

Vegetables contain active pharmacological substances that are important in human nutrition and treatment, i.e. phytochemicals: phenols, vitamins, minerals, dietary fibre, and glucosinolates, which are also largely responsible for the specific taste and smell of both the vegetables and the dishes prepared from them. Unfortunately, the consumption of cabbage and its preparations is falling in Poland, and some vegetables, e.g. rutabaga, have almost lost their significance because they are associated, as a synonym of poverty, with periods of war and hunger, when they were a basic staple, mainly used to make soups, and often from poor quality raw material. However, due to dietary and health-promoting values, cabbage, rutabaga, and other vegetables are worth popularizing in the cultivation and preparation of dishes by promoting regional and traditional products.

In addition to culinary values brought by vegetables, the production and sale of vegetable products and traditional regional dishes prepared from them is an opportunity to increase the income for farmers and small producers from rural areas, especially those who are associated with the place of manufacture of a given product, or the place of origin of the raw material or technology. They also allow the development of local resources, which include knowledge and awareness of tradition in a given area, a chance for the development of broadly understood rural tourism and gastronomy services as well as culinary tourism [Krupa 2014, Jóźwik 2019].

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9

Buckwheat as vanished plant ingredient in traditional meals in the eastern part of Slovak Republic

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Abstract. Buckwheat is a plant cultivated for its grain-like seeds and as a cover crop and is usually used as an alternative cereal. Two major varieties of buckwheat are Common buckwheat (*Fagopyrum esculentum* Moench.) and Tartary buckwheat (*Fagopyrum tataricum* Gaertn.), which belongs to the *Polygonaceae* family. With another species in the same genus, common buckwheat, it is often counted as a cereal, but unlike the true cereals, buckwheat is not a member of the grass family. Thus, they are not related to true wheat. Buckwheat seed can be stored for a long time, without significant chemical alteration, because it contains antioxidant phytochemicals. Differences in the antioxidant properties of buckwheat are related to the cultivars and environmental effects.

The eastern region of Slovakia touches borders with Poland and Ukraine. This region has its characteristic cultural heritage. The inhabitants of this region are mostly Rusyns. This national minority in Slovakia is famous for their traditions, culture, language, and especially food. One of the traditional meals of the region includes 'Tatarčane pirohy' – 'Tatar dumplings'. They are made from ingredients characteristic for this region like potatoes, buckwheat and wheat flour, cheese, chives or dill, onions, milk, butter or lard, and salt. Tatar dumplings are usually filled with cheese, potato, bryndza cheese, sour cabbage, plum jam, etc.

Keywords: buchwheat • Tartary buckwheat • food • meal • tradition

9.1. Introduction

Buckwheat has been grown for centuries and is now one of the most important alternative crops and is a valuable raw material for functional food production [Krkošová and Mrázová 2004]. Buckwheat – Fagopyrum belongs to the family *Polygonaceae*, but the determination of Fagopyrum's generic name had undergone many modifications. Until now, Fagopyrum should be viewed as an independent genus according to the morphological, palynological, and cytological studies [Zhou et al. 2018]. This plant group is generally referred to as the buckwheat, rhubarb, or sorrel family [Campbell 1997]. From their initial domestication in southwestern China, common (or 'sweet') and Tartary (or 'bitter") buckwheat have traveled together southward into the Indian subcontinent, eastward to Korea and Japan, and westward to Europe and North America [Katsube-Tanaka 2016]. More recently, common buckwheat has also become a commercial crop in Brazil and Australia. In Chinese, common buckwheat is called tian qiao; Tartary buckwheat is ku qiao [Scheucher 2004] or ku chi mai. While Tartary buckwheat has all but disappeared from many of the areas to which it had been introduced, it remains a significant crop in its native country. In China, according to Zhao et al. [2018], over 300 varieties of Tartary buckwheat were being grown on 1.0 to 1.5 million hectares in 2004, distributed mainly in provinces south of the Yangtze River.

9.1.1. Tartary buckwheat, classification

The genus *Polygonum* is distributed worldwide, mostly in north temperate climates. It is interesting from both a biological and phytochemical perspective [Narasimhulu et. al. 2014]. In the tribe Polygoneae of the subfamily Polygonoideae, there are seven genera, namely, Antenoron, Fagopyrum, Fallopia, Koenigia, Polygonum, Pteroxygonum, and Reynoutria [Hao et al. 2015]. The *Polygonaceae* are a family of flowering plants known informally as the knotweed family or smartweed — the buckwheat family in the United States. The name is based on the genus *Polygonum* and was first used by Antoine Laurent de Jussieu in 1789 in his book, Genera Plantarum [de Jussieu 1789]. The name may refer to the many swollen nodes the stems of some species have, being derived from Greek, poly meaning 'many' and gony meaning 'knee' or 'joint'. The *Polygonaceae* comprises about 1200 species distributed into about 48 genera. For example, there are 235 *Polygonaceae* species and 37 varieties in China [Hao et al. 2015]. The *Polygonaceae* family is present worldwide but is most diverse in the North Temperate Zone [Al-Sunafi 2016].

The Polygonaceae family has leaves that vary in size, arrangement, and shape, but the leaf stalk is always surrounded by a membranous or chaffy sheath at the base [Campbell 1997]. The flower is bisexual, and its perianth is white, pale red, or yellowish-green, and has five deep lobes, but isn't accrescent. Every flower has eight stamens, five of which are the inner ones and three are the outer ones. The pistil consists of three carpels, which can be divided up into a prismatoidal ovary and three styles (heterostylous or homostylous). The furrows of pollen grain are perforated and rough in exine, which forms the granular pattern [Zhou et al. 2018].

Box 1. Key for the determination of *Fagopyrum* species as described by Ohnishi (1995)

1	thick plaited cotyledons lie in the centre of the achene	*(Fagopyrum)*	2
2	cotyledons horizontally long, large lusterless achene is partially covered with persistent perianths		3
2*	cotyledons laterally long or round, small lusterless grains are completely covered with persistent perianths		4
3	cotyledons in endosperm are colourless, blade veins are transparent		5
3*	cotyledons in endosperm are yellowish, blade veins are transparent		6
5	heterostylous and cross-pollinating species	*F. esculentum*	
5*	homostylous, self-fertilizing species	*F. homotropicum*	
6	surface of achene is smooth	*F. cymosum*	
6*	surface of achene is rough, with a canal in the centre	*F. tataricum*	
4	five perianths are equal in size, the lower two lack a green stripe		7
4*	perianths consist of two smaller and three larger: the lower small perianths have greenish stripes		8
7	perennial with well-developed roots	*F. statice*	
7*	annual with a poor root system		9
8	ochrea is green and not transparent	*F. urophyllum*	
8*	ochrea is transparent with greenish stripes		10
9	achene are relatively large and plants are vigorous	*F.* u_e	
9*	achene are very small and plants are small and slim		11
10	ochrea is not pubescent, main blade vein number is 5		12
10*	ochrea is pubescent, main blade vein number is 7		13
11	blades are ovate or cordate	*F. leptopodum*	
11*	blades are linear	*F. lineare*	
12	plants are erect	*F. callianthum*	
12*	many branches are creeping on the ground	*F.* u_f	
13	ochrea is not heavily pubescent, stem is not pubescent, it has many creeping branches	*F. pleioramosum*	
13*	ochrea are heavily pubescent, stems also pubescent		14
14	ochrea and stems heavily pubescent, blades are cordate or sagittate, inflorescences are drooping	*F. gracilipes*	
14*	pubescence in ochrea and stems is not as heavy as *(F. grac.)*, blade cordate or ovate, branches are erect	*F. capillatum*	

Source: Ohnishi [1995]

Fig. 9.1. Key for the determination of *Fagopyrum* species

The genus *Fagopyrum* consists of about 19 species, only two of which, namely *F. esculentum* and *F. tartaricum*, are cultivated. The members of the genus fall into two phylogenetic groups, the *cymosum* group and the *urophyllum* group. The *cymosum* group is comprised of two cultivated species, *F. esculentum* and *F. tartaricum,* and four wild species, viz. *F. cymosum, F. homotropicum, F. lineare*, and *F. pilus*. The *urophyllum* group, on the other hand, consists of *F. urophyllum* and the rest of the wild species [Chrungoo et al. 2011].

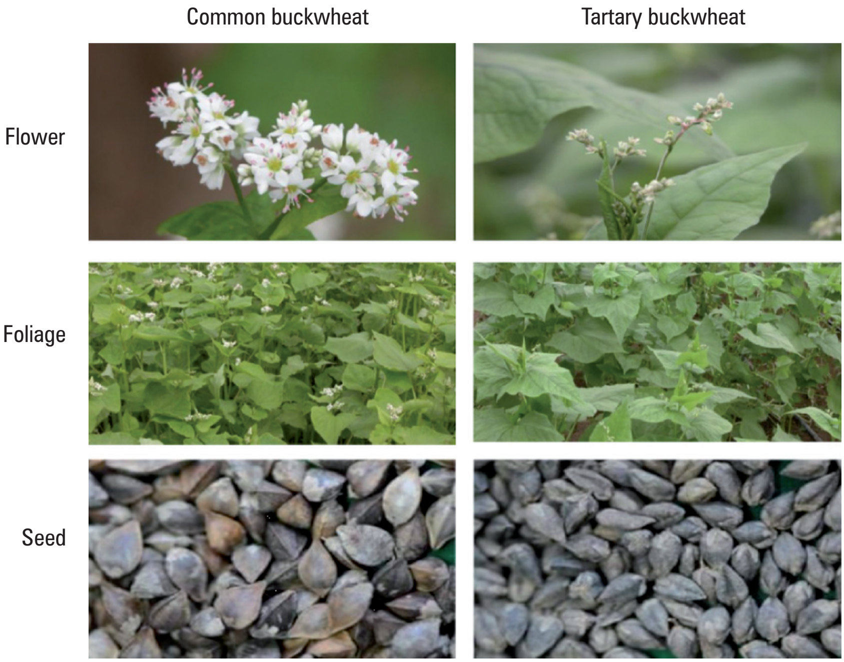
Buckwheat is a traditional crop in Asia and both Central and Eastern Europe [Wijngaard and Arendt 2006]. Buckwheat is introduced into the diet as an alternative crop of renewed interest due to its nutritive and health-promoting value [Christa and Soral-Śmietana 2008]. Common buckwheat (*Fagopyrum esculentum* Moench) is the most commonly grown species, while two other species of buckwheat (*F. tataricum* Gaertner and *F. emarginatum*) have been cultivated on a small scale [Marshall and Pomeranz 1982, Mazza and Oomah 2005]. Buckwheat is categorized as a pseudo-cereal in that it shows both differences and similarities with cereals [Aufhammer 2000].

Source: Woo et al. [2016]

Fig. 9.2. Morphological differences between common and Tartary buckwheat

9.1.2. The buckwheat production

The main producers of buckwheat are China, the Russian Federation, Ukraine, and Kazakhstan [Li and Zhang 2001, Bonafaccia et al. 2003]. It is also produced in Slovenia, Poland, Hungary, and Brazil [Kreft et al. 1999]. Over the last 40 years, China has been the largest producer of buckwheat [Wijngaard and Arendt 2006]. In 2004, China produced 1,500,000 Mt, followed by Russia and Ukraine which produced 649,560 Mt and 293,400 Mt, respectively [FAO 2004]. There are some botanical and physiological similarities between buckwheat and weeds, one of them being the ability to correct growth without the use of artificial fertilizers or pesticides [Kreft et al. 1996]. Moreover, buckwheat absorbs less water and lower amounts of nutrients from the soil than other main crops [Li and Zhang 2001].



Source: Lee et al. [2016]

Fig. 9.3. Comparison of the general morphology of commond and Tartary buckwheat

In recent times, buckwheat is considered a food component of high nutritional value. Buckwheat is rich in vitamin B_1 and $B_{2,}$ it has balanced amino acid composition and is rich in lysine [Watanabe 1998]. Potential antioxidants, such as tocopherols and phenolic substances, namely 3-flavanols, rutin, phenolic acids, and their derivatives are present in buckwheat [Ohsawa and Tsutsumi 1995, Oomah et al. 1996, Watanabe et al. 1997]. Buckwheat appears to be a suitable component of food products for its nutritional aspect and antioxidant activity [Holasova et al. 2002]. The main product from a buckwheat plant is its seed. It is a rich source of starch and contains many valuable compounds, such as proteins, antioxidative substances, trace elements, and dietary fiber [Bonafaccia et al. 2003]. Traditional buckwheat breeding was aimed at the development of new varieties with high yield and the technological properties of grains, which enhance the yield of processed whole groats. The complex composition of buckwheat grains and different distributions of chemical compounds in grain parts can be used in the food industry and for breeding [Bobkov 2016].

9.1.3. Physicochemical composition of buckwheat

9.1.3.1 Proteins

Buckwheat proteins contain albumins, globulins, prolamins, and glutelins. They do not contain gluten [Skerritt 1986, Wieslander and Norbäck 2001, Bobkov 2016]. Proteins are the second major component of buckwheat seeds, after carbohydrates. Besides starch and the compounds collectively labeled as dietary fiber, the seeds of buckwheat contain several soluble carbohydrates. Some of these are as common as sucrose, but others are not found widely in other plant species [Wieslander and Norbäck 2001]. According to Ikeda et al. [1991], common buckwheat seeds consist of 64.5% globulin, lysine (6.1% of 100 g of amino acid recovered). In addition, buckwheat contains high levels of arginine (9.7%) and aspartic acid (11.3%), and low levels of proline (3.9%) and glutamic acid (18.6%), when compared with cereals [Pomeranz and Robbins 1972]. Chinese cultivars of Tartary buckwheat, Qin et al. [2010] reported an average crude protein concentration of 10.50 percent of flour dry weight. The average for flour from 18 cultivars of common buckwheat was 10.32 percent – not significantly different. The range in protein content in flour from the Tartary buckwheat cultivars was 6.82 to 15.02 percent, almost twice the range of 8.06 to 12.44 percent in common buckwheat cultivars [Qin et al. 2010]. Common buckwheat is considered an important source of dietary protein. Depending on the ecotype, the variety of protein content in buckwheat flour varies from 8.51% to 18.87% [Krkošková and Mrazová 2005]. Guo and Yao [2006] studied the fractionation and characterization of Tartary buckwheat flour proteins. They extracted albumin, globulin, prolamin, and glutelin, from Tartary buckwheat flour. Albumin was the predominant protein fraction (43.8%) followed by glutelin (14.6%), prolamin (10.5%), and globulin (7.82%). Albumin was relatively rich in histidine, threonine, valine, phenylalanine, isoleucine, leucine, and lysine. Globulin had high levels of methionine and lysine. Prolamin was high in histidine, threonine, valine, isoleucine, and leucine. Glutelin was rich in histidine, threonine, valine, isoleucine, and leucine [Guao and Yao 2006]. According to Drobot et al. [2014], about 80 percent of buckwheat protein comprises albumin and globulin. Cereals, in contrast, contain relatively higher levels of prolamins. This difference is one of the factors that give buckwheat its higher water-retaining capacity. That water-retaining capacity, in turn, imparts stickiness to a dough that contains buckwheat flour. Compared with common buckwheat protein, Tartaty buckwheat protein and its Osborne fractions, albumin, globulin, prolamin and glutelin, have been scarcely researched. Tomotake et al. [2002] studied the physicochemical and functional properties of the buckwheat protein product. Their study was conducted to compare the physicochemical and functional properties of the buckwheat protein product, soy protein isolate, and casein, wheare they found that the amino acid composition of buckwheat protein product was very similar to that of buckwheat flour. More research is needed to increase our knowledge of these protein types [Guao and Yao 2006].

High serum (i.e., blood) concentrations of cholesterol and related lipids have been implicated in cardiovascular disease. It is well known that buckwheat is an edible and rich source of rutin, a flavonol glycoside compound (quercetin-3β-D-rutinoside) [Ujihara 1994]. Tartary buckwheat seeds, for example, have a high rutin content of about 1.5% [Minami 1998]. It has been reported that rutin is effective in improving the capillary fragility responsible for maintaining normal blood pressure [Iwata et al. 1990]. However, there has been no evidence as to whether rutin is directly involved in lowering blood pressure. Iwata et al. [1990] demonstrated that the long-term feeding of Kangra buckwheat to a spontaneously hypertensive rat resulted in a significant blood pressure reduction of 14%, as well as a reduction in the plasma triglyceride level after 4–6 weeks.

9.1.3.2 Starch

Starch is the major storage component of buckwheat grains. Buckwheat species are considered pseudocereals because their seeds – like those of true cereals – contain relatively high concentrations of storage carbohydrates [Wijngaard and Arendt 2006]. It is accumulated in the endosperm as an energetic material necessary for plant growth. In the whole grain of buckwheat, starch content varies from 59% to 70% of the dry mass, demonstrating fluctuations under variable climatic and cultivation conditions [Qian & Kuhn 1999]. However, current results of the starch analysis in buckwheat grains of three Polish varieties have shown that the starch content lies in a narrow range, i.e. from 63% to 66% d.m. [Stempińska and Soral-Śmietana 2006]. Buckwheat seeds exhibited a higher carbohydrate percentage of 73.3% due to the presence of the pericarp but had a similar starch percentage (55.8%) [Wijngaard and Arendt 2006]. The percentage of starch (57.4±0.12%) in Tartary buckwheat was slightly higher than in common buckwheat, but this could be due to the cultivar analyzed in this particular study [Bonafaccia et al. 2003].

Sindhu and Khatkar [2016] also investigated the functional properties of this Tartary buckwheat starch. They reported a bulk density of 0.65g per ml, an indication that the starch would function well as a thickening agent. The starch had a water absorbance capacity of 91.1 percent and an oil absorbance capacity of 92.5 percent. These values represent the ability of the starch to hold water or oil, respectively, against the pull of gravity. Starch can be divided into three groups depending on the rate and extent of digestion in vitro: rapidly digestible starch, slowly digestible starch, and resistant starch [Wijngaard and Arendt 2006]. Resistant starch can again be divided into three groups: physically inaccessible starch, native granular starch, and retrograded starch, while processing of buckwheat can affect the resistant starch [Englyst et al. 1992]. Milling and cooking can reduce the percentage of resistant starch from seeds, however, retrogradation can increase that percentage, e.g. the level of retrograded starch can be increased by either autoclaving or boiling from 1% to 4–7% [Skrabanja et al. 2001].

9.1.3.3 Lipids

Compared to cereals, both common and Tartary buckwheat are relatively rich sources of lipids, particularly unsaturated fatty acids. In samples of several accessions, the two species showed a minor but consistent difference in fatty acid profiles. Despite the predominance in both species of unsaturated steric and linoleic acids, oils in buckwheat seeds were relatively stable during prolonged storage [Soral-Śmietana et al. 1984, Bonaffacia et al. 2003]. Buckwheat grains contain from 1.5% to 4% of total lipids [Steadman et al. 2001], but the content of raw fat in buckwheat flour exceeds 3% [Soral-Śmietana 1987]. Free lipids isolated from buckwheat grains constitute 2.5% of d.m., whereas bound lipids – about 1.3% d.m. [Soral-Śmietana et al. 1984]. It was demonstrated that in buckwheat flour the content of free lipids is higher than that of bound lipids, but the reverse situation was observed after the extrusion process [Soral-Śmietana 1987]. The highest concentration of lipids was found in the embryo (7–14%), whereas the lowest in the hull (0.4–0.9%) [Bonaffacia et al. 2003]. Mazza [1988] measured various lipid fractions in groats of the three cultivars of common buckwheat then most widely grown in North America and found that total lipids represented from 2.6 to 3.2% of dry weight. The concentration of neutral lipids was highly correlated with total lipids ($r = 0.94$) and ranged from 1.6 to 2.2% of dry weight. In all classes of lipids from all three cultivars, oleic (C18:1) and linoleic (C18:2) fatty acids predominated, with palmitic acid (C16:0) having the next highest concentration. Linoleic acid is considered an essential nutrient since it is not synthesized by the human body [Bivins et al. 1983]. The prevalence of unsaturated fats, buckwheat seeds that had been stored for 25 months at room temperature nevertheless showed very little change from fresh seeds in their fatty acid profile [Mazza 1988]. Tsuzuki and collaborators [1991] reported the fatty acid profiles of groats from ten accessions of Tartary buckwheat collected from several countries. The observed ranges were 16.0–17.5 percent palmitic acid (C16:0), 1.8–2.3 percent stearic acid (C18:0), 0.9–1.2 percent arachidic acid (C20:0), 0.9–1.1 percent behenic acid (C22:0), and 0.5–0.7 percent lignoceric acid (C24:0). Of total fatty acids, 33.5–39.3 percent were oleic acid (C18:1), 33.9–39.7 percent were linoleic (C18:2), 1.3–2.6 percent were linolenic acid (C18:3), 1.9–2.3 percent were gadoleic acid (C20:1), and 0.5–0.6 percent were C22:1. Comparing these Tartary buckwheat accessions with 24 diverse accessions of common buckwheat, each species showed a relatively consistent and distinctive profile of fatty acids. Tartary buckwheat contains relatively less C18:3 and C20:1 but more C22:1 unsaturated fatty acid than does common buckwheat. Bonafaccia et al. [2003] reported the following fatty acid profile for a single Tartary buckwheat cultivar from Luxembourg. Saturated fatty acids with 16, 18, 20, and 22 carbon atoms constituted 19.7 percent, 3.0 percent, 1.8 percent, and 0.8 percent, respectively. Unsaturated C18:1, C18:2, C18:3, and C20:1 fatty acids constituted 35.2 percent, 36.6 percent, 0.7 percent, and 2.0 percent, respectively. Due mostly to the greater proportion of palmitic acid (C16:0) in the Tartary buckwheat, the ratio of unsaturated to saturated fats was smaller than in the common buckwheat cultivar, 'Sivi' (2.94 versus 3.87). Sindhu and Khatkar [2016] reported that crude fat constituted 2.42 percent of the dry weight of flour from whole seeds of Tartary buckwheat (cultivar 'Shimla-B1'). In flour made from 21 cultivars of Tartary buckwheat, Qin et al. [2010] found that the percentage of fat varied from 1.2 to 4.7 percent. The minimum and maximum in flour from 18 cultivars of common buckwheat were 1.5 percent and 5.4 percent fat, respectively.

9.1.3.4. Minerals and vitamins

Ash, the various minerals remaining after the tissue is burned, constitute about 2–3 percent of the dry weight of buckwheat seeds, and a slightly smaller percentage of the groats. Grown on soils high in aluminum or lead, buckwheat could accumulate high concentrations of those metals. Among the accessions of buckwheat grown in a common field, concentrations of lead, tin, and chromium in seeds were highly correlated. Concentrations were generally higher in roots, stems, or leaves than in seeds. Concentrations of minerals were generally higher in Tartary than in common buckwheat. Concentrations were generally higher in the bran than in pale flour. In some Tartary buckwheat teas from China, some elements were found at toxic concentrations; plants grown for food should not be grown on polluted soils. On the other hand, foliar applications of selenium can increase that element's concentration in seeds, augmenting dietary sources in areas where selenium is deficient.

Generally, the content of minerals in buckwheat grains and their morphological fractions (dry base) reaches 2–2.5% in whole grains, 1.8–2.0% in the kernel, 2.2–3.5% in dehulled grains, about 0.9% in flour, and 3.4–4.2% in hulls [Li and Zhang 2001]. Buckwheat is rich in potassium (K), magnesium (Mg), calcium (Ca), and sodium (Na). P, K, and Mg are concentrated in bran the most, particularly in the bran from which the hulls were removed before milling the grains. Buckwheat may be an important nutritional source of such microelements as iron (Fe), manganese (Mn), and zinc (Zn) [Wei et al. 1995]. Trace elements, e.g. chromium (Cr) or selenium (Se), are occasionally detected at very low levels. Stibilj et al. [2004] reported after cultivation experiments reported that foliar fertilization makes buckwheat grains a rich source of dietary Se and useful raw material for enriched food products [Steadman et al. 2001, Wei et al. 2003, Stibilj et al. 2004]. Buckwheat grains were also demonstrated to contain vitamins: B1, B2, B6 [Fabjan et al. 2003]. These are concentrated in the peripheral parts of endosperm and embryo; hence the highest quantity of B vitamins is found in the bran. Tartary buckwheat bran contains about 6% of daily therapeutic doses of pyridoxine [Schynder et al. 2001], effective in the reduction of blood plasma homocysteine levels.

9.2. Functional properties of buckwheat

Buckwheat is not only a food crop but possesses a lot of beneficial health properties thanks to several components of its grain as protein, starch, minerals, and fibers [Brunori et al. 2010]. Researchers have studied mainly antioxidant properties and chemical substances in buckwheat, like flavonoids, because the presence of these compounds in the human and animal diet has been shown to benefit their health. Scientists also focused their research on quercetin and three of its glycosides – isoquercetin, quercitrin, and rutin. Concentrations of these flavonoids vary among different plant tissues and over the maturation cycle, which may vary with harvest conditions and subsequent processing of buckwheat in the process of preparing food [Li and Zhang 2001].

Tartary buckwheat may even contain more bioactive components than common buckwheat. For instance, it has been reported that the flavonoid content of Tartary buckwheat is higher than that of common buckwheat. The flavonoid content was 40 mg/g in Tartary buckwheat seeds as compared to 10 mg/g in common buckwheat seeds [Li and Zhang 2001]. The comparative composition studies of common buckwheat and Tartary buckwheat show higher thiamine, riboflavin, and pyridoxine contents, and they are an excellent food for use in preventative nutrition [Liu et al. 2008]. When buckwheat is processed, flavonoid levels and, therefore, the antioxidant activity can be affected. When buckwheat is heated to 150°C, the flavonoid concentration is reduced. A reduction of flavonoid concentration of 20% has been determined when buckwheat is heated for 10 min at 150°C, and a reduction of 40% has been determined when buckwheat is heated for more than 1 hr and 10 min at 150°C [Wijngaard and Arendt 2006].

Rutin is one of the important bioactive substances in F. tartaricum. Rutin has many physiological and biological properties, including antioxidation, antiinflammation, antihypertension, vasoconstrictive effect, and positive inotropic effect

[Vojtiskova et al. 2012, Zhou et al. 2016]. A large number of studies have shown that the rutin content of *F. tartaricum* is more than that of *F. esculentum* [Campbell 1997, Fabjan et al. 2003, Yan et al. 2004, Gupta et al. 2012]. However, it is the component rutin which makes buckwheat a unique cereal grain. Rutin is for sure one of the most beneficial plant bioactive compounds as the large and growing scientific literature would prove [Christa and Soral-Śmietana 2008]. Unfortunately, the content of rutin in the grain of *Fagopyrum esculentum* (common buckwheat), the species commonly utilized in food preparations, is too low to provide the amount of rutin (40–100 mg/d) necessary to secure preventive activity with respect to the potential expected health benefits: reduction of capillary fragility, anti-inflammatory properties, antihyperglycemic activity, antimutagenic activity, anticancer activity, mitigating the effect of diabetes consequences [Brunori et al. 2010].

The digestion of buckwheat releases compounds that can bind cholesterol in the intestine, and thereby assist its excretion in feces. Researchers, therefore, hypothesize that buckwheat consumption can lower cholesterol levels in the blood, and reduce the concomitant risk of cardiovascular disease. Binding of cholesterol would also diminish its availability to bacteria in the lumen of the large intestine. Carcinogenesis in the colon and rectum is promoted by bacterial derivatives of bile acids [Narisawa et al. 1974]. High serum (i.e., blood) concentrations of cholesterol and related lipids have been implicated in cardiovascular disease. It is well known that buckwheat is an edible and rich source of rutin, a flavonol glycoside compound [Ujihara 1994]. Tartary buckwheat seed, for example, has a high rutin content of about 1.5% [Minami 1998]. Iit has also been reported that rutin is effective in improving the capillary fragility responsible for maintaining normal blood pressure [Iwata et al. 1990]. However, there has been no evidence as to whether rutin is directly involved in lowering blood pressure. Iwata et al. [1990] demonstrated that the long-term feeding of Kangra buckwheat to spontaneously hypertensive rat (SHR) resulted in a significant blood pressure reduction of 14%, as well as a reduction in the plasma triglyceride level after 4–6 weeks.

9.3. Traditional diet with tartary buckwheat

The cultural region of the Eastern part of Slovakia has its characteristic cultural heritage. The inhabitants of this region are mostly Rusyns. The major compound of meals in this region are plant products such as potatoes. However, one of the traditional meals of the region includes 'Tatarčane pirohy' or 'Tatar dumplings'. They are mainly produced from ingredients characteristic for this region like potatoes, Tartary buckwheat and wheat flour, cheese, chives or dill, onions, milk, butter or lard, and salt. Tatar dumplings are usually filled with cheese, potato or bryndza cheese, sour cabbage, plum jam, etc.

9.3.1. Tatarčane pirohy – Tatar dumplings

Ingredients for one family: 4 large potatoes, buckwheat flour (about a quarter to grated potatoes), 1 kg of semi-hard flour, bryndza cheese, salt, chives or dill, oil, butter, 300 mL of milk, smooth flour, 1 onion.
Directions:

1. Grate the potatoes, add buckwheat flour in a ratio of about 1:4 (We can prepare the buckwheat flour in grinder when the whole buckwheat is milled).
2. Sieve the buckwheat flour and add the semi-hard flour (the ratio is three parts Tartary buckwheat to one part semi-hard flour). Mix the dough until it does not stick and has the correct consistency. It is interesting that neither a drop of water nor an egg comes into the dough.
3. Roll out the dough and cut out the square dumplings, to be filled. The filling consists of bryndza cheese with salt and chives or dill. However, there are other options, e.g. a stuffing of potato with bryndza cheese or sour cabbage prepared after wash in water, subsequently chocked up and mixed with choked up onion.
4. Place the dumplings separately in salted boiled water. When they rise to the surface they are finished cooking.
5. Put the dumpings in a bowl with lard and pour over the dumpling sauce made from bryndza cheese mixed with fermented cream. Do not wash them before moving them into the bowl. They can be topped with roasted onions or cracklings.

Photo: B. Semjon

Fig. 9.4. Homemade 'Tatarčane pirohy'

9.3.2. Buckwheat noodles – Soba noodles

In Japan, master soba makers trained in their craft from childhood make soba noodles by hand. One hundred percent pure buckwheat noodles are notoriously difficult to fabricate and famously driven to break. The reason: buckwheat flour is weak, lacking the strength given to wheat flour by a protein called gluten (https://ansonmills.com/recipes/631).

Ingredients: cup buckwheat flour; 1/2 cup Kamut or white spelt flour (can also substitute with all-purpose flour); 130 to 150 mL hot water

Directions:

1. Combine the buckwheat flour and Kamut or spelt flour in a large mixing bowl. Add the water gradually, and then work the flours and water together, kneading to form the dough. If at any point the dough feels too crumbly, add a little more water. Alternatively, if the dough is too sticky, add a little more Kamut or spelt flour.
2. Knead the dough until it comes together in a smooth, round ball, then turn it out on the counter and knead it with the heel of your hand. The dough should be soft and smooth; if any cracks appear, add a little more water.
3. Once it's smooth, shape the dough into a flat rectangular parcel. This will help the dough keep its shape as you roll. Sprinkle the semolina or buckwheat starch onto the counter and lightly over top of the dough, which will prevent sticking. Now it's time to start rolling out the dough: The best way is to roll from the center outwards, shaping the edges as you go so that the dough remains rectangular. This will save you from having to trim later.
4. Spread a generous handful of semolina or buckwheat starch over the dough. Then fold the top third of the dough down and spread it with more starch. Fold the bottom third of the dough upwards, like you would fold a letter, and coat that with the semolina or starch, as well. Begin cutting the noodles approximately half a centimeter (a quarter of an inch) thick.
5. Keep slicing until you have used all of the dough. Toss the cut noodles with a little more semolina or starch so that they don't stick together.
6. Bring a large pot of water to a boil, salt the water generously, and drop in the soba. Cook the noodles for one minute, then drain them, and rinse them under cool water immediately.
7. Use your hands to lift and gently shake the noodles as you rinse them; this helps to remove the starchy film that coats the noodles as they cook. After rinsing, drain the noodles and serve them cold or at room temperature. I like to toss the noodles with garlic oil, toasted sesame oil, and soy sauce. Then I scatter chopped spring onions and toasted cashews over top and finish the salad with chunks of mango.
8. The noodles store well in the fridge for a couple of days, and I often double the recipe and store the leftovers in a Tupperware for handy lunches.

9.3.3. Homemade buckwheat pasta

Buckwheat pasta can be easily prepared at home. For two portions, use 1 cup of buckwheat flour and ½ cup of semi-hard flour and 150 mL hot water.
Directions:
1. Knead the dough by a mix of the buckwheat flour and semi-hard flour with water, until it comes together in a smooth consistency.
2. Keep the prepared dough in the fridge for 30 minutes.
3. Divide the dough and roll out the dough on the counter.
4. Begin cutting the noodles or knots of approximately half a centimeter thick.
5. Place noodles separately in salted boiled water. When they rise to the water surface, they are successfully cooked. Take them out from the water and add butter or lard.
6. It is possible to prepare the buckwheat pasta in salty variety with bryndza cheese, fermented cream, onion, and cracklings, or in sweet variety with plum jam.

Buckwheat pasta can be used in many ways, you can find tradition or modern recipes on the internet.

Photo: B. Semjon

Fig. 9.5. Buckwheat noodles – salt variety with cheese, cracklings and fried onion

Photo: B. Semjon

Fig. 9.6. Buckwheat pasta – sweet variety with plum jam

9.3.4. Buckwheat sourdough

Buckwheat has a very unique flavour and aroma and is a great for adding depth to your baking. Unfortunately, buckwheat flour does not form gluten so baking with it can be a challenge. Scalding the buckwheat flour before adding it to the dough allows a much higher amount of buckwheat to be added to the loaf while still getting a nice open crumb. This loaf is very moist and stays well for many days. (https://anitasorganic.com/recipe/buckwheat-sourdough/?fbclid=IwAR29H8rcMeMnSZ-qxMBosaBaNyDtdu66lEAHP0tk6h8Tu4mpPvGOJmnQSeA).

Ingredients:
For the Levain: 130 g buckwheat whole grain flour, 130 g water, 15 g mature sourdough culture. For the Buckwheat Scald: 170 g buckwheat whole grain flour, 400 g very hot water (80°C). For the final dough: 335 g buckwheat whole grain flour, 200 g whole wheat flour, 310 g water (room temperature), 17 g fine sea salt.
Directions:

1. Mix the levain ingredients and let stand at warm room temperature (23–24°C) for 8–12 hours. Look for a 50% increase in volume. When ready, it should have a fruity tangy smell and taste. A younger levain will yield a milder flavour in the final loaf and a longer fermented levain will result in a more sour loaf.

2. Prepare the buckwheat scald by combining the buckwheat flour and hot water. Stir vigorously to prevent clumps from forming. The water must be at least 80°C to properly gelatinize the starch of the buckwheat. Let cool to room temperature.
3. One hour before the final mix, combine the flour and water (no salt) of the final dough until fully incorporated with no dry bits left. Cover the dough and allow to rest for one hour.
4. Add the levain and salt to the flour/water mixture and hand mix to incorporate.
5. Use the 'slap and fold' technique to develop the gluten in the dough. 5–6 minutes. If you are unfamiliar with this technique refer to our sourdough guide on the website.
6. Mix the scalded buckwheat in by hand thoroughly by squeezing it into the dough with your thumb and fingers and alternately pulling up the sides of the dough and pressing it back down into the center.
7. Slap and fold the dough for another 2 minutes or until you have completely incorporated the buckwheat.
8. Ferment for 4 hours at warm room temperature (23–24°C) with three folds at 30, 60, and 90 minutes.
9. Divide the dough into two 850 g pieces and preshape into a light ball.
10. Bench rest for 20 minutes.
11. Shape the loaf into either a Boule or Batard depending on the shape of your proofing basket, dust with rice flour and place into your proofing basket. A bowl lined with a tea towel will also work if you don't have a proofing basket.
12. Proof approximately 2 hours at warm room temperature until it has gained 50–75% volume. You can also proof for 1 hour and then retard in the fridge for 8–36 hours.

Photo: B. Semjon

Fig. 9.7. Buckwheat bread

13. Preheat the oven to 240°C with a cast iron dutch oven inside for at least 45 minutes. Placing the dutch oven on top of a pizza stone will prevent the bottom from getting too dark. See the sourdough guide for other baking methods.
14. Turn the dough out onto a piece of parchment. Score and place in the preheated dutch oven with the lid on. Reduce the oven temperature to 230°C. Remove the lid after 20 minutes and continue baking 10–20 minutes until deep brown. A fully cooked loaf will have an internal temperature of 90°C.
15. Cool the loaf fully before cutting (at least one hour). If the loaf is cut while it is still hot, it may end up with a gummy interior. This is especially important with this loaf due to its very high moisture content.

9.3.5. Tartary buckwheat sugar cookies according to Angelica Mill recipe

1. Combine in a food large processor or else hand whisk together: 3,5 cups Tartary buckwheat flour, 1 cup Tartary buckwheat bran, 2 scant teaspoons baking soda, 1 cup 10× (confectioners) sugar. Transfer mixture to a large bowl.
2. Use a food processor to mix the following: 2 eggs, 2 tsp vanilla, 1/2 cup honey, 1/2 cup light vegetable oil, add the liquid mixture to the dry ingredients, and stir together until well mixed.
3. Form into two balls and refrigerate for an hour or more. You can roll out the dough without chilling, but you'll need to put plenty of extra flour on the counter to keep the dough from sticking.
4. Roll to desired thickness; thin will make crisp wafer-like cookies, while thick will make cake-like cookies. Use cookie cutters to shape. With a thin spatula, transfer cookies to a cookie sheet covered with parchment paper.
5. Bake in a preheated 180ºC oven for 11 minutes for thin cookies or 14 for thicker cookies. Remove from oven and cool on racks. These will freeze beautifully.

9.4. Conclusion

This chapter discusses the buckwheat used as an alternative cereal for the production of traditional meals with a plant basis. It describes the two major varieties of buckwheat, Common buckwheat (*Fagopyrum esculentum* Moench.) and Tartary buckwheat (*Fagopyrum tataricum* Gaertn.). Buckwheat seed can be stored for a long time, without significant chemical alteration, because it contains antioxidant phytochemicals. The basic physicochemical composition and functional properties of the two major kinds of buckwheat were described in relation with the use of the Tartary buchwheat in traditional meals. The 'Tatarčane pirohy' – 'Tatar dumplings' are one of the typical meals in the region of Eastern part of Slovakia, which borders with Poland and

Ukraine, and is inhabited mainly by Rusyns, national minority in Slovakia. This national minority is famous with their own traditions, culture, language and especially food. The produced meals are specific and characteristic for this region of the Eastern Slovakia an important component of human nutrition here and can be an indicator for a culturally diverse region.

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10

North Carpathian herbs. Properties and application in food and folk medicine

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Abstract. The Carpathian Mountains are one of the most valuable areas of Poland. They occupy only about 7% of the area of the country were here more than 85% of vascular plants that occur in Poland grows. 20% of them occur only here. In the Polish part of the Carpathians, there are about 2,100 species of vascular plants (including plants of foreign origin). It is known that plenty of them may be useful for food preparation and folk medicine. The tradition of herbs utilization in especially poor local societies has more than a hundred years. On the other hand, the Carpathian and Subcarpathian region of Poland may still be designated as a nonpolluted area in which wild plants and mushrooms may be found and use with no danger to the consumers.

Nowadays only a few traditional herbs are in use while the long tradition clearly shows hundreds of different species that were collected and used. They disappeared for decades but are still worth it to be remembered and to rediscover. The plants used in both kitchen and folk medicine are the jewels and cultural heritage of lesser Poland and are characteristic of the culture of local communities and national minorities.

Keywords: Carpathian Mountains • herbs • functional properties

10.1. Introduction

Wild food plants have always been part of the human diet [Harlan 1992]; they have long provided people with a 'hidden harvest' [Scoones et al. 1992] and 'back-up resource' [Menendez-Baceta et al. 2012]". They have been *particularly important* in times of food shortages [Łuczaj et al. 2012]. The tradition of consuming wild food plants could survive for a longer time in forested and mountain regions unsuitable for agricultural production [Dénes et al. 2012].

During hunger regimes, people often faced the dilemma of whether to eat plants they do not know. Wild plants aroused also respect because of their 'magic' or healing power [Łuczaj 2013, Pirożnikow 2014]. They played a special role in folk medicine. Appropriate methods at that time were both rational and based on magic or other religious beliefs. Many kinds of grass, herbs, and flowers that were used in the form of bouquets or wreaths were used during the holidays and various rites [Łuczaj 2013].

Among wild plants, herbs attract special attention. The term herb comes from the Latin word *herba* and means grass or herbaceous plant [Halarewicz 2015]. The tradition of herbs utilization in especially poor local societies has more than a hundred years. Moreover, the Carpathian and Subcarpathian region of Poland may still be designated regarded as a non-polluted area in which wild plants and mushrooms may be found and used with no risk of harm to the consumers [Piękoś-Mirkowa and Mirek 2003].

Nowadays, only a few traditional herbs are in use while a long tradition clearly shows hundreds of different species that were collected and used. They disappeared for decades but are still worth to be remembered and deserve to be rediscovered [Łuczaj 2013].

Modern, the popularity of gathering and consumption of wild plants is growing again. Some plant species are appearing in markets as sources for fashionable 'natural products' [Dénes et al. 2012].

10.2. The Carpathian Mountain system

The Carpathians are the second largest mountain range on the European continent that covers more than 1.500 km across seven European countries being located in the very heart of the continent [Kricsfalusy 2013]. The region is not only of historical and cultural importance, but it is also valuable because of nature conservation. Rich biodiversity attracts special attention, with several relics and endemic plants and animals [Vanderplank et al. 2014]. It is worth emphasizing that the Carpathian Mountains, being one of the most valuable areas of Poland, occupy only about 7% of the area of the country on which more than 85% of vascular plants that occur in Poland grow. Twenty percent of polish Carpathian plants may only be found in the region.

Among 2,100 species of vascular plants (including plants of foreign origin) growing in the Polish part of the Carpathians can be useful for food preparation and in folk medicine. Thus, this region holds a strong potential for cultivation, collection, and manufacture of medicinal plants and plant-based natural ingredients; in the forested, mountain regions (being unsuitable for agricultural production). The tradition of consuming wild food plants could last here for a long time having origin in the middle ages and before. Moreover, plants were also the only medicines available to people from the mountain regions [Kozłowska et al. 2018]. According to their botanical provenances, therefore, it is a crucial basis for understanding the ethnic cultures [Kozłowska et al. 2018].

These plants being used both in kitchen and folk medicine, are the jewels and cultural heritage of Lesser Poland. They are characteristic of the culture of local communities and national minorities [Łuczaj 2013]. Within the context of ethnic plant medicine, strong preferences for the local use of such species such as St John's-wort (*Hypericum perforatum* L.), wormwood (*Artemisia absinthium* L.), garlic (*Allium sativum* L.), gentian (*Gentiana lutea* L.), lovage (*Levisticum officinale* W.D.J. Koch), and lesser periwinkle (*Vinca minor* L.) were observed [Kozłowska et al. 2018].

The centuries-old tradition of using herbs is closely related to learning about their properties and chemical composition, which is largely responsible for sensory effects (food production and preparation) as well as medicinal and therapeutic effects. Combined with traditional plant processing methods such as drying, salting, and fermentation, it is also an inexhaustible source of inspiration in contemporary culinary culture and herbalism.

Starting from the beginning, the usage of plants in European medicine was formalized by works of Hippocrates, Dioscorides, Pliny, Avicenna, and Galen [Kozłowska et al. 2018]. Medieval Slavic herbal tradition could be found in the Izbornik manuscripts, presenting medicinal uses of plants such as hemlock, wormwood, or henbane. Next, herbal manuscripts (Polish *zielnik*) from the 16th to 18th centuries combined traditional herbal medicines with magical applications [Kozłowska et al. 2018]. Indeed, there was a strong link between magic and the belief in the curative power of herbs. The knowledge of phytotherapy was derived from people's age-long coexistence with nature [Kuźnicka and Wysakowska 1993].

For example, cabbage and beet leaves were prescribed for the management of fever and pain, onion and garlic against infections, and a mixture of horse and goat manure to cure alopecia in 3 days [Krylov 1985, cit. Kozłowska et al. 2018]. In the 17th century, the practices of trained physicians and apothecaries became regulated by pharmacopeias. Simultaneously, the local knowledge of healers and witchcraft practitioners were restricted [Ostling 2014, cit. from Kozłowska et al. 2018]. The combined knowledge of printed herbals and handwritten manuscripts are deeply rooted in the oral tradition of folk remedies. This is why the ethnographic studies of the region (from the 19th and early 20th century) recorded traditional folk medicines as a part of local 'heritage' – cultural and ethnographic [Kozłowska et al. 2018].

Herbs, as well as other wild plants, have been used in the northern slopes of the Carpathian range for the preparation of traditional dishes made from both animal products like cheese, quark, and meat products as well as plant-based dishes including traditional pastries, bread, etc. Dried herbs were also used as spices or salt substitutes. The well-known way of processing herbs was also used for the preparation of some water and alcoholic infusions, which were used as drinks or medicinal tinctures. Traditional recipes clearly show the richness of flavors and aromas that regional dishes owed to the use of these herbs in various forms [Mamiński 2016]. It is to emphasize that gathering traditions, being regulated by unwritten laws, went from generation to generation [Dénes et al. 2012].

10.3. Chemical composition of herbs

Nutrients play a building, energetic, and regulating role in the human body. Plants can contain both non-nutritional and nutritional ingredients. These include proteins, fats, carbohydrates, mineral salts, and vitamins. On the other hand, non-nutrient ingredients, i.e. active biological substances, may exert a beneficial effect on the human body. In this group of essential oils, alkaloids, phenols, flavonoids, anthocyanins, glycosides, tannins, phytoncides, glucosinolates, fiber, and pectins play an important role [Troszyńska et al. 2000].

The nutritional value of plants is determined by their chemical composition, which is very diverse. The specific properties of herbs and other plants result mainly from their non-nutritional ingredients, i.e. biologically active substances. They are responsible for flavouring properties and also have a beneficial effect on the body and human health. Therefore, herbs have been used for a long time, mainly for the prevention and treatment of many diseases [Kudełka and Kosowska 2008, Łuczaj 2013].

In herbal medicine, various anatomical parts of plants can be used, i.e. their organs including fruits and seeds, underground parts (rhizomes, roots, onions, etc.), as well as leaves or stems [Łuczaj 2013].

Fruits and seeds contain a lot of storage components intended for the development of young plants [Szwejkowska and Szwejkowski 2004]. Depending on the type of storage material seeds can be divided into floury or oily. Some seeds are particularly rich in protein that has similar biological function and value as animal proteins. Vegetable protein contains the same amino acids set but they vary in protein proportion that depends on the plant. The seeds also contain salts and phytates [Szwejkowska and Szwejkowski 2004]. In some cases the husk of the seeds may contain poisonous saponins, therefore many of the seeds should be soaked in water before consumption [Łuczaj 2013]. The fruit is a good source of vitamin C, B vitamins as well as vitamins K and E. Many fruits is also a good source of carotenoids and polyphenols. They also contain valuable organic acids.

The roots, rhizomes, and bulbs of plants are organs that are widely used in herbal medicine. They are storage organs allow the plant to survive the winter period, hence they are and have been available for consuming and processing in the winter season. In the underground parts, plants can accumulate a lot of storage substances which may be used for spring growth. The most common storage material is starch, which is a most common source of energy. In some complex (e.g. Jerusalem artichoke) and monocotyledonous plants inulin is the reserve material as well. Inulin is not absorbed through the human digestive system. As it passes through the body, inulin is fermented, but it can be broken down into absorbable fructose by baking or frying. In addition, it is worth to mention that inulin is the basic nourishment for intestinal bacteria that facilitates the absorption of many micronutrients [Łuczaj 2013]. The roots of many wild plant species also contain a lot of fiber [Łuczaj 2013].

The leaves and stems contain a lot of water and non-digestible cellulose (fiber), additionally small amounts of sugars and proteins and vitamins (especially vitamin C, provitamin A and folic acid) and other compounds like chlorophyll [Łuczaj 2013, Płocharski et al. 2017].

There are many plant species in herbal medicine, the leaves of which are as valuable as seeds or fruit. The leaves of these plants are not only health-promoting, but also often taste good. The edibility of the leaves of a given species usually depends on their age. Predominantly young leaves are edible (e.g. beetroot leaves – older organs are hard and bitter). In some plants, the leaves are edible only after thermal treatment – such as young fern leaves [Łuczaj 2013].

Dried leaves and flowers are also a valuable raw material for the preparation of infusions, which are made of species containing many active, biologically active substances, which in larger quantities can even be toxic and addictive, such as tea, marjoram, mint, yarrow etc. [Łuczaj 2013].

10.4. Examples of Carpathian herbs – properties and application in food and folk medicine

Broadleaf plantain (*Plantago major* L.)

This plant belongs to the *Plantaginaceae* family, perennial. It flowers from June to October. Reaches variable height from 5 to 30 cm, depending on the habitat. Develops a bundle root. The stem of the plant is strongly shortened. Leaves are collected in a basal rosette, with broad-ovoid leaf blade, all-round. Flowers with reduced peduncles, gathered in top, cylindrical ears. Inconspicuous, small yellow-green perianth. The fruit is a capsule opening with a lid that contains 6–10 brown oval or non-oval seeds. The plant is common in Poland. It grows on roads, roadsides, ditches, and meadows. It contains flavonoids, tannins, pectins, vitamins C, and K, as well as organic acids (citric, fumaric, benzoic, and cinnamon). Plantain leaves are a common herbal raw material known since antiquity. The most commonly used of the plant is preparing infusions which are used to treat respiratory and digestive diseases or to prepare antitussive mixtures. This is because of the iridoid glycosides contained in this plant that contain anti-inflammatory and mucous compounds. The leaves can also be applied directly to wounds because they have antibacterial properties and give a stop bleeding effect. Plantain leaves are suitable for various types of soups, dishes a la spinach, or as an addition to fried vegetables. They can also be eaten separately, e.g. baked in pancake batter. Seeds after cooking are mucous and very nutritious, they can be used as a gelling agent. Seeds can be cooked like porridge or added to bread and pastries. They taste a bit like linseed [Łuczaj 2013, Halarewicz 2015].

Wild garlic (*Allium ursinum* L.)

A plant belonging to the *Liliaceae* family. In medieval Europe, this plant was grown for spice and vegetable purposes. Currently, it is only found in its natural state. In Poland, it may found throughout the whole country but is common in mountain deciduous forests. This plant is partially protected in Poland. It easily reproduces by bulbs and seeds. It is a permanent plant that blooms from April to May. It grows on moist, slightly acidic soils and shady places. It is hardy. Bear's garlic reaches a height of 20–50 cm. It grows clumps, sometimes forms large compact fields. A small, oblong bulb is characteristic of the plant. The stem is triangular, raised, and leafless. It usually produces two ovate-lanceolate leaves that grow directly from onions, similar to lily of the valley leaves. The inflorescence shoot is finished with loose umbel inflorescence. Snow-white flowers with petals much longer than stamens. The fruit is a bag with six seeds bursting into three parts. After the vegetation period, the aboveground part disappears. Bear's garlic contains volatile oils, vitamin C, E, provitamin

A, mineral salts: phosphorus, magnesium, and potassium. This plant has a high iron content (30% more than in common garlic). It is characterized by strong bactericidal properties. Until recently, bear garlic was hardly known in Poland but has recently become fashionable. This plant should be used fresh, as dried loses most of the active substances. The leaves are very tasty raw (like onions) and are great as an addition to sandwiches and salads. They also go well with pasta, tomatoes, and cheese. Leaves and bulbs are easy to pickle (like cucumbers). Bear's garlic has antiseptic, antibiotic, and antifungal properties. It is useful in the treatment of the upper respiratory tract. Wild garlic tincture is a known folk remedy. Young, chopped leaves are poured with alcohol and set aside for about three weeks. After this time, the tincture is ready for consumption. One glass a day is enough to prepare the body for the coming autumn and winter. Bear's garlic also stimulates the immune system to fight against cancer cells and is sometimes used as an adjunct in the treatment of colon or stomach cancer. The plant is a source of vitamins A, C, and E, or antioxidants, which protect against the development of atherosclerosis, hypertension, blood clots, heart disease, strokes, and cancer. It has a beneficial effect on the cardiovascular system because it lowers cholesterol and triglyceride levels. It also contains numerous micro- and macroelements – manganese and zinc, sulfur, and iron. Sulfur contained in bear's garlic is one of the components of collagen and connective tissue that builds tendons, joints, and cartilage. For this reason, it is recommended to people who are struggling with rheumatic diseases. The sulfur compounds help to keep the skin, hair, and nails in perfect condition. Perfect for people who are struggling with persistent acne – sulfur has soothing inflammation. It can be not only internally, but also externally in the form of compresses or as an ingredient in homemade masks based on yogurt or honey [Łuczaj 2013, Halarewicz 2015].

St John's wort (*Hypericum perforatum* L.)

St. John's wort belongs to the St. John's wort family is a medicinal plant known since antiquity and widely used due to its biological properties. The name 'hypericum' consists of two parts derived from the Greek language: 'hyper' means 'over, through', and 'eikon' – a ghost, ghost. This is due to the belief that the plant could protect against evil. The word 'perforatum' originating from Latin means 'punctured' due to the characteristic structure of the leaf [Cybula et al. 2005]. St. John's wort is a perennial plant with bright yellow flowers grown all over the world. The name St. John's wort comes from the small glands on the leaves of the plant that look like holes – these places are containers of the medicinal oil. It is a plant that reaches a height of 30–80 cm and even 100 cm. Pedunculated and flower shoots grow from the rhizome. Stem erect, bare. Opposite leaves, bare. Leaf-blade transparently dotted, with glands on the edge. The transparent dots contain tanks for essential oils. Petal flowers are gathered in a compact group. They have a five-petaled crown with numerous stamens, and the petals are yellow with black dots.The fruit is a multi-seeded bag covered with glands. Black seeds, finely dotted. Young leaves and flowers can be added to salads and fish dishes. In addition, tinctures and liqueurs can be prepared from it. Herb shoots are young shoots and flowers. Shoots are cut just before flowering because during and after flowering they become lignified and have much lower medicinal value. Flowers are plucked from the stems and dried outstretched in a thin layer. They may be then dried in thin bunches, hung on a cord with flowers down. The plant has a strong spicy aroma and tart taste [Rejewski 1992, Łuczaj 2013]. St. John's wort owes its healing properties to the substances contained in this plant: hypericin (red pigment), flavonoids, hyperoside – a diuretic, routine and quercetin – seal capillaries, tannins – anti-diarrheal and bacteriostatic, hyperforin (obtained from seeds) – has antibiotic properties [Cybula et al. 2005). St. John's wort contains essential oils, resins, organic acids, pectins, choline, mineral salts, sugars, vitamins A and C. The most important diseases in which St. John's wort is used are diseases of the digestive system, skin, difficult to heal wounds, and the nervous system. The beneficial effects of St. John's wort in the treatment of stomach upset and stomachache has been long known. It also acts as a diastolic agent on the smooth muscles of the digestive system and bile ducts. It is less known as a blood vessel sealant (like vitamin PP), improving the blood supply to internal organs. In cholangitis, cholecystolithiasis, 'weakening' of liver secretory function, gastroenteritis, good results may be decoction: A light St. John's wort decoction can be used to wash the skin with acne, abscesses, and ulcers. St. John's wort essential oil is sometimes found in creams and skin regenerating emulsions [Cybula et al. 2005].

St. John's Wort turned out to be a boon to modern man, who is increasingly persecuted by depression, anxiety, and general discouragement from life. The beneficial effect in the treatment of depressive conditions St. John's wort is due to the content of hypericin. Hypericin, according to clinical studies, inhibits the breakdown of neurotransmitters (serotonin), which inadequate in the body gives symptoms of a bad mood, anxiety, and depression. St. John's wort extracts have similar efficacy as standard antidepressants used in the treatment of mild to moderate depression. St. John's wort also finds application in ailments of menopausal women – it works then especially for ailments caused by depression – because many women have hidden or overt depression at this difficult time. It is also used in the case of excessive irritability before menstruation, in the so-called premenstrual syndrome. Through its beneficial effects on the digestive system, St. John's wort increases the absorption of B vitamins, the presence of which is necessary for the work of the nervous system [Cybula et al. 2005].

Common juniper (*Juniperus communius* L.)

Juniper is a shrub belonging to the *Cupressaceae* family. In Poland, in the wild, the plant is common in lower mountain locations. It may also be cultivated as a decorative shrub. The cone-berry berries are suitable for harvesting in the second year after flowering. In the first year after formation, they are green and cannot be ripened. They are widely used in home and folks herbal medicine for digestive problems, kidney, and bladder diseases. It is a plant used not only in Polish cuisine, as a spice for venison and will last from cabbage. They are valued in the kitchen due to the spicy, resinous, and bitter-sweet taste as well as its balsamic aroma. Oil distilled from pineapple, and sometimes also from young twigs and wood, has found wide application. Fruits contain up to 2% of essential oil with a fairly variable chemical composition. The main components of the oil are terpineol, pinene, camphene, and myrcene. In addition, the fruit contains up to 40% sugars, humps, flavone glycoside, resins, and waxes. The amount of oil is variable and depends, among others from the fruit's origin, date of harvest, method of drying, and also from its size: small fruits are richer in oil [Rejewski 1992]. Dried juniper berries are used in cured meats (hunting sausages, juniper), for meat and poultry, for venison, and are also used as a spice for fish and flour dishes. Juniper is also flavored with herb vinegar. Juniper beer was also made from pineapple. In their poorest form, they were grated with cones and blueberries with yeast, but where possible they were fortified with honey or sugar, sometimes hop cones were added. Occasionally, vodka is also made from pineapple.

Juniper oil has fungicidal and antibacterial effects. However, it does not significantly affect blue oil rod, *Candida albicans*, *Staphylococcus aureus*, and colon rod (although studies indicate significant antibacterial activity also for these last two species. It is recommended to use juniper after antibiotic treatment of infections of the urinary tract, which prevents the recurrence of infection and destroys other bacteria resistant to antibiotics. It is particularly recommended for antibiotic-resistant infections [Rejewski 1992, Łuczaj 2013, Halarewicz 2015]. Flavonoids, and to a lesser extent essential oil with terpineol contained in it, are also intended to have a diuretic effect. It is believed that the spasmolytic effect (smooth muscle relaxants) is the result of the irritating effect of the oil, which also causes congestion of the renal parenchyma. As a result, juniper is used in ailments associated with water and sodium ion retention in renal failure. Pineapple extracts are also credited with increasing the secretion of bile and gastric juice. They also stimulate peristalsis, sweat secretion, and dilate the capillaries of the skin causing its redness. Due to the content of pinene and other terpenes in the oil, it also irritates the skin. Juniper oil is part of the warming ointments used for rheumatic pain and neuralgia [Łuczaj 2013].

Lovage (*Levisticum officinale* Koch.)

This plant belonging to the *Apiaceae* family. A species probably come from Persia, cultivated all over Europe. Sometimes it gets wild. It is a perennial plant. For the winter period, the aboveground part dies completely, blooms in July and August. Lovage prefers sunny places and tolerates most soils except heavy and clay. It is a strongly propagating perennial, with a stem up to 2 m high, diameter at the base up to 5 cm, with a strong aroma reminiscent of celery. Brass stem, densely foliage. Leaves glabrous, shiny, double-bottomed, single-pinnate at the top, with long-tailed leaves, inversely broad-leaved, thickly notched-toothed. Pale yellow flowers gathered in top umbels. The fruit is a double split. All parts of the plant are very aromatic with the smell and taste of the celery. Chopped leaves are added to soups, especially those that contain potatoes and legumes. It can be used to season salads, herb butter, cottage cheese, and sauces. Cut whole shoots are a tasty addition to stewed meats, pies, and vegetables fried in oil. In English cuisine, the stalks are eaten as steamed asparagus. Stalks prepared this way can be candied and used to decorate cakes and desserts. Whole or ground splinters are added to sweets, crackers, cakes, various types of bread, and biscuits. Moreover, the herb root is used to produce many herbal mixtures, Maggi type spices, bouillon cubes, and instant soups. It is known primarily for its diuretic and supportive effects in urinary tract diseases. It also relaxes the intestinal muscles. The properties of lovage help the body get rid of toxins. Due to the content of coumarin, it has an anticoagulant effect. It contains plant sterols, i.e. phytosterols, which help the body fight against atherosclerosis and prevent its formation. Thanks to confirmed expectorant action, it can also be used in the case of a dry and persistent cough. Lovage supports the body by increasing its physical and mental capacity. It is helpful in troublesome ailments caused by stomach ulcers and psoriasis. Thanks to the content of essential oils, it improves blood supply to the genitals, which in turn contributes to better sex life. It is not without reason that it is added to hard-to-digest food – it facilitates digestion and prevents excessive fermentation in the intestines. Supports the body in case of indigestion and relieves troublesome bloating [Łuczaj 2013, Halarewicz 2015].

Horse mint (*Mentha longifolia*)

Horse mint is a species belonging to the *Lamiaceae* family. Long-leaved mint reaches a height of up to 100 cm. The stem is erect, softly pubescent. Leaves oblong or lanceolate, the edges unevenly serrated, sessile, or short-tailed. Leaves are hairy or covered with cutter. Flowers gathered at the tops of shoots in cylindrical inflorescences. The cup is hairy. Pink or red lily crown. The fruit is a cleavage that breaks into 4 shards. Long-leaved mint is a long-lasting plant. The flowering period from June to September. Prefers soils rich in nitrogen and calcium, moist. It inhabits moist meadows. Contains volatile oils. The most famous of them is menthol. In addition, it is characterized by the content of compounds such as vitamin C, flavonoids, and tannins. This plant stimulates digestion, has antispasmodic, cholagogue, and bacteriostatic effect. Infusions from this plant are one of the most commonly used folk remedies for humans and animals. Near Babia Góra, mint leaves were added to a soup called warmuz, together with the leaves of nettle and white quinoa. The leaves were also brewed with infusions, used as a seasoning for soups, or made into stuffing for dumplings. In ancient times, refreshing, cooling taste and aromatic smell were used to season wines. Currently, fresh and dried mint are both used in the kitchen. The former is recommended for sweet dishes and drinks such as iced tea and punch. The mint flavor also goes very well in meat and fish dishes. Dried leaves are used for baking bread and for making kvass [Łuczaj 2013, Halarewicz 2015].

Common nettle (*Urtica doica* L.)

Common nettle is a perennial species, belongs to the *Urticaceae* family. This species is very variable in terms of size, the shape of leaves and inflorescences, as well as the degree of hairiness. Single stalk, weakly branched, usually up to 1.5 m high. The stem is four-leafed, covered with denser or less bristly secretory mating hairs and fewer non-mating hairs. Underground, the plant produces strongly branched sympodial and woody shoots with age. Fibrous roots grow from the rhizome nodes. Curled foliage. The leaf blade has a variable shape, from broad-leaved to narrow-lanceolate. The leaves are coarsely serrated at the edge, sometimes double. The end of the lamina is sharp, usually long. The plant is usually dioecious. The flowers are inconspicuous (up to 1.5 mm in diameter), green, with a four-part flowering body, they are gathered in loose or dense acicular inflorescences longer than the petioles, growing from the groin of the leaves [Halarewicz 2015]. There are 4 stamens in male flowers. In these flowers, two perianth leaves are larger and two smaller. Female inflorescences are hung after flowering. The fruit is monocotyledon, ovoid, or narrow-elliptic and slightly compressed nuts up to 1.2 mm long, surrounded by persistent perianth leaves and often with preserved remains of the pistil at the top. Nettle leaves contain a lot of iron and magnesium as well as vitamins A, C, and B vitamins. Juice squeezed from leaves or infusion is drunk for medicinal purposes (cleanses the blood, has a strengthening and anti-haemorrhagic effect). Nettle has been used as a medicinal plant since the dawn of time, e.g. in the treatment of hay fever, arthritis, and anemia [Pieszak and Mikołąjczak 2010]. Moreover, fresh plants were used for whipping in rheumatism or paralysis. Nettle is used in many ways – it is a medicinal and cosmetic, edible, and feed plant, it also provides fibers, dye, and is used in gardening. Nettle also plays a role in human spiritual culture. Due to the presence of stinging-burning hair, it causes painful irritation to the skin of people and animals. Leaves and whole young shoots are edible. The leaves and stems of nettles are covered with formic acid-secreting glands. Cooking or drying removes burning properties. Due to its universal availability, pleasant taste, and nutritional qualities, it can be used for soups and dishes a la spinach, it can be used as an ingredient in pizzas, tarts, addition to baking bread, pates, silage, etc. Leaf juice or decoction can be used instead of rennet for the production of vegetarian dairy products. Beer can be made from young nettle leaves. Nettle has many properties. Very often nettle can be found in the composition of natural cosmetics. Nettle has, among others, strengthening properties, which is why it is recommended for drinking as a tea in autumn and winter when it is most often attacked by pathogenic viruses and bacteria. Nettle also has diuretic properties; therefore, it increases the amount of urea excreted from the body and is recommended for people suffering from kidney stones and struggling with water retention. However, because of this, it can cause deficiencies of mineral salts and vitamins in the body, which will be washed out of the body, so nettle tea should be consumed in moderation. Nettle has a positive effect on hair and nails due to the high content of vitamins B1, C, E, and K, as well as phosphorus, manganese, silicon, or calcium, which are also extremely needed for the whole body to function well. Nettle tea is often recommended for skin problems, especially acne, which has a bacterial basis because nettle has antibacterial properties. It also cleanses the body of toxins, so it will remove acne bacteria, but also cleanse the liver, pancreas, or stomach, which disturbed work can negatively affect the skin. Nettle can also be infused for digestive problems, diarrhea, and intestinal or gastritis [Pieszak and Mikołąjczak 2010, Łuczaj 2013].

Comfrey (*Symphytum officinale* L.)

Comfrey is a perennial plant belonging to the family *Boraginaceae*. Occurs commonly in wet ditches, on wet meadows, roadside, and forest edges. The native area of occurrence of this species includes Europe (except for its southern extremities) and Central Asia. In Poland, this plant is common. There are two more species in the Carpathians: bulbous comfrey and heart-shaped comfrey. Comfrey reaches a height of about 30–100 cm. Comfrey has purple, pink, and white flowers, depending on where it occurs. It develops a thick, fusiform, almost black root. Stem thick, branching, raised. Twisted foliage, large pointed leaves, all-round. This plant blooms from May to June. The fruit is black, smooth, and shiny schist. Edible parts are leaves and flowers, the roots are also nutritious, but they contain significant amounts of toxic alkaloids, so they can only be consumed in small amounts. Comfrey (roots, to a lesser extent leaves) has been used in herbal medicine for centuries, mainly externally as a wound healing accelerator due to the content of melatonin that stimulates cell proliferation. It should not be eaten in large quantities, because it contains a certain amount of poisonous pyrrolizidine alkaloids (after a long time they can damage the liver, they are also carcinogenic) [Łuczaj 2013]. Occasional eating of leaf dishes is not dangerous. In Poland, comfrey leaves have been used traditionally since the beginning of the 20th century and only in the pre-harvest period. They were prepared like cabbage – chopped and cooked with spread, this dish is called szabaga. He was also often added to pancakes. Currently, both fresh and dried leaves are used in the kitchen. Fresh young leaves are a great addition to salads. The leaves can also be fried in beer batter. Such comfrey leaf chips can be served hot or sweet. Shredded leaves are used as an addition to meat or vegetarian stuffing. Dried leaves are part of the herbal blends used in the form of teas. The internally used root extract has a beneficial effect on the intestinal and stomach mucous membranes. The root contains many valuable substances in herbal medicine. About 10–15 percent the composition of the root is mucus; the other ingredients are allantoin, tannins, fructans, polyphenols, asparagine, silicon, amino acids, beta-sitosterol, and essential oil. Allantoin contained in the root of this plant has an effect on tissue regeneration, accelerates wound healing, has strong moisturizing properties. This substance has been valued in the cosmetics industry for years. It has a softening and smoothing effect, accelerates skin regeneration, protects it from sunburn. It is used to relieve psoriasis and prevent pressure sores. In addition, it has anti-inflammatory effects [Halarewicz 2015].

Angelica archangelica L., *Archangelica officinalis* Hoffm.

Angelica archangelica is a biennial plant growing up to 2.5 m in height, with a stem carrying large leaves two and three-pinnate, heart-ovoid, unevenly serrated. It is characterized by small greenish-white flowers gathered in powerful inflorescences – umbels, 20–30 peduncles each. It flowers from late May to July. Fruits are oval, up to 10 mm long and 6 mm wide, flat. It inhabits fertile humus and well-drained soils. Prefers sunny and semi-shaded positions. It is a perennial found in Poland in the highlands. The whole plant is strongly aromatic. Contains volatile oils, carbohydrates, glycosides, and tannins. The whole plant, especially rhizomes, roots, and fruits contain angelica oil (0.25–1%). It has a characteristic spicy, pleasant aroma. Contains coumarin, furocoumarin, angelicin. He found used in medicine as an appetite and expectorant. The herbal raw material is dried root. Externally, the oil obtained from the root is used for all kinds of pain and bruises. It is also used in the spirits industry to make various tinctures and liqueurs. In confectionery, stalks are usually candied and used to decorate cakes and pies. Preserves are made from young stems and thicker petioles. The leaves can be used when frying acidic fruit. Angelica is a plant whose healing properties were already appreciated in the Middle Ages. The monks of that time called the angelica as the Herb of the Holy Spirit and recommended chewing its roots (*Radix archangelicae*), which are medicinal, to achieve longevity. Modern phytotherapy recommends the use of preparations from this herb (including infusions, tinctures) in digestive system disorders – as a remedy for ulcers, indigestion, or stimulation of appetite. Angelica in the form of infusions will also soothe the nerves, and in the form of rubbing oils will relieve rheumatic pains or radiculitis. On the other hand, angelica lotions will work on greasy hair and dandruff. In addition, angelica is a method of treating vitiligo and other skin diseases in folk medicine [Rejewski 1992, Halarewicz 2015].

10.5. Conclusion

To sum up, it is worth to know that worldwide, a lot of plant species are used for their medicinal properties. This study includes plants that have been accompanying people for a long time. These plants are characteristic of areas that are poor in terms of climate, soil, etc. (including mountainous areas). Described plants have been providing valuable nutrients for centuries and were also a source of religious beliefs.

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11

Tekov region in Slovakia as the territory of Black mulberry (*Morus nigra* L.) presence as a part of cultural heritage

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Abstract. Black mulberry (*Morus nigra* L.) is considered to be neglected fruit species on the Slovak territory. The largest documented local concentration of black mulberries in Europe can be found in the vineyards of Pukanec village and in its neighborhood in the Tekov region. Since Pukanec with its approximately 500 yield-bearing trees of 350 years of age represents the largest locality of its type on the territory of Europe, these mulberry trees were in 1988 declared as a protected natural creation called 'Pukanec black Mulberries'. In experimental studies inventory, monitoring, evaluation, and cataloging of mulberry genotypes spread in Slovakia were performed. There were 964 trees found in total. In an experimental study, trait variability was determined on the level of trees, leaves, flowers, fruits, and seeds for 470 selected genotypes from Pukanec village. Black mulberry fruits and derived products are rich in biologically active compounds and can be used in the food industry and human nutrition. Anthocyanins are highlighted as the most important components and are used for nutritive purposes. Free radical scavenging activity in black mulberry food products ranged from 50.81% in wine to 74.02% in sterilized fruits in honey.

Keywords: black mulberry Pukanec • biologically active compounds • anthocyanins • DPPH

11.1. Introduction

Black mulberry (*Morus nigra* L.) is botanically included in the genus Morus and family Moraceae. Genus Morus consists of 12 species, growing in the tropical and subtropical climate zones [Rehder 1956]. Black mulberry is a highly interesting species, taking into account the nutritional, phytotherapeutic, or pharmaceutical point of view.

Black mulberry (*Morus nigra* L.) is botanically included in the genus Morus Minamizawa [1997] and Bendel [1999] declared that the mulberry place of origin is the Caucasus region. Since wildly growing black mulberries are unknown, it is difficult to find the original descent area [Zeleny and Grünerova 1982]. Its transfer to Western Europe is ascribed to Greeks and Romans, and in Slovakia, it was introduced later from West Europe as archaeobotanist identified seeds of mulberry (*Morus nigra* L.) from the 14–15th century [Hajnalová 1999].

In the Tekov region, two theories about the introduction of mulberries in Slovak territory are known [Mikuška 2002]:

By the first theory, the Romans brought it to the Slovak territory. The Roman introduction was the most important in the area of the Malé Karpaty, where the Romans brought vines (*Vitis vinifera*). This theory is reinforced by the fact that mulberry is bound to vineyards (often found directly in the vineyard between the rows of vines) and its folk name is 'vine strawberry' or 'vine mulberry' [Benčať 1996].

The second theory assumed that mulberry was introduced from Turkey. One of its folk names is 'Turkish mulberry'. According to this old name, it could come from Turkey and get to Slovakia during Turkish raids to Europe and Slovakia in the 16–17th centuries. Since the age of the oldest trees is estimated to be about 500 years, we must also consider this possibility. Some scientists rule out this possibility, arguing that the Turkish invasions were aimed at plundering rather than introducing new fruit species. This problem is explained by an old legend, in which when the Turks raided, mulberry cakes were packed from the house, and when they dropped a seed, this germinated in the spring [Mikuška 2002].

Black mulberry (*Morus nigra* L.) is a dark green colored deciduous shrub, medium-sized tree, growing up to 6–9 (15–35) m in height which has a broad, dense spreading crown. The trunk is short. The leaves are petiolate, leathery (scabrous on the upper face and pubescent on the lower), large (5–16 × 5–16 cm), variable in shape: whole or palmately lobate. The leaf blades are asymmetrical, broadly ovate, deeply cordiform at the base, and shortly acuminate on top, obtusely dentate along the edge. Flowers are small, unattractive, clustered in catkin-like inflorescences. Fruits are 1.5–2.5 cm in length and 3 cm in diameter, black, glossy, sweetish sour, juicy, and very tasty [Burkill 1985, Alonzo 1999, Chukhina 2015]. Compared to the white mulberry, the black mulberry tree is shorter, with a smaller and more regular crown. Its shoots and branches have a bright yellow color. The fruits of Morus nigra ripen earlier and are smaller, juicier, and tastier than those of Morus alba [Turskienė 2013].

Fruits of black mulberry could be consumed directly or used for the production of syrup, compote, jam, and/or alcoholic drinks [Bendel 1999]. Black mulberry (*Morus nigra* L.) is known not only for its nutritional value and taste but is highly appreciated for its use in traditional human medicine as well, based on the higher content of biologically active substances [Alonzo 1999].

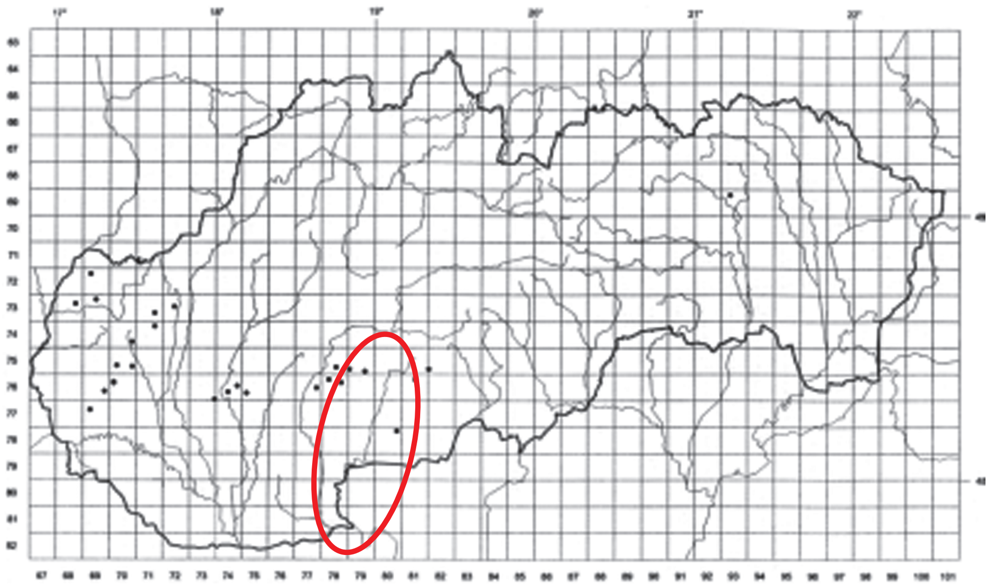
11.2. Materials and methods

The experimental study was performed from 2003 to 2006. Activities were focused on the monitoring and inventory of mulberry trees growing in Western and Central Slovakia in 29 village cadastres. Individual trees selected for further research were geographically localized with GPS coordinates, altitude, slopes, locality, and estimated age. The second stage was characterized and described the traits of trees, buds, leaves, flowers, and fruits by morphometric and chemical analyses. On the mulberry, habitats were determined the tree height (in meters), crown width (in meters), and the health status. Morphometrically have estimated the characters of main and side buds (length, width, thickness, 10 replicated measurements per genotype), male/female inflorescences (length, width, 5 replicated measurements per genotype), leaf and leaf stem length (30 replicated measurements per genotype), blade of the leaf (length, width, 30 replicated measurements per genotype), and fruits (length, width, weight, 30 replicated measurements per genotype). Detailed research was focused especially on the Tekov region, which is historically known for the abundance of black mulberry trees (Fig. 11.1).

Tekov is situated on the border of western and central Slovakia. Tekov takes quite a long north-south strip that is adjacent to the northern boundary Turiec and the southern boundary is near the border with Hungary. The northern part Tekov is filled with mountains Pohronský Inovec, Vtáčnik, Kremnické hills, Štiavnické Hills and southeastern slopes Tríbeč. Tekov region is identical with the territory of the former Tekovská county and is now divided into three Self-governing Region: Nitra, Banská Bystrica, and a small part extending into the Trenčín territory. The agricultural area has a dominant presence in terms of land use – 67% of the area of the territory [Prčík and Kotrla 2014].

For complex evaluation 470 mulberry genotypes in Pukanec village cadaster were selected. The village of Pukanec is located at the foot of the south-eastern slopes of the Štiavnica Hills, in the northern part of the Bátovská basin, at medium altitude.

The location and south-east orientation of the slopes of the surrounding mountains make the Pukanec climate warm, less humid, with mild winter. It is characterized by 50 summer days (above 25°C) and an average annual temperature of around 9°C. Below −20°C, the temperature drops approximately once every thirty years. Summer highs often approach 34–35°C [Bahna 2010].



Source: Authors' own study

Fig. 11.1. Occurence of black mulberry (*Morus nigra* L.) in the Slovak Republic, highlighted area is Tekov region

Black mulberry (*Morus nigra* L.) fruits were collected from the trees in Pukanec village at an altitude of 330–480 m above the sea level. The ripened fruits were collected; the berries were transported to a laboratory for analysis. Samples were identified as MN (*Morus nigra*) and an appropriate number.

11.2.1. Preparation of black mulberry products

The fresh fruits were collected and analyzed and then food products were made by a traditional procedure using processing methods of inhabitants of village Pukanec in Slovakia:

a) Natural juice was obtained from fresh fruits. For this processing, the homogenously ripened fruits were selected and mixed with a blender. A sieve was used to eliminate the seeds; the extract was then pressed softly to increase the yield.

b) Natural juice from fresh fruits using hot steam.
c) Fresh fruits are conserved in honey with a ratio of 1:3 without sterilization.
d) Fresh fruits conserved in honey with a ratio of 1:3 with subsequent sterilization at 85°C.
e) Jam produced from fresh fruits by the traditional procedure (using sucrose with ratio 1:5).
f) Jelly produced from fresh fruits by traditional procedure (using sucrose ratio 1:6).
g) The syrup was produced from fresh fruits by traditional procedures with the addition of sucrose with a ratio of 1:8.
h) Liqueur was made from fresh fruits by traditional procedure with 90% ethanol (final concentration of ethanol in liqueur was 22%).
i) The compote was made from fresh fruits with sucrose with a ratio of 1:2.
j) The wine was made from fermented fresh fruits and production time was 21 days until the concentration of 12% ethanol was reached. Briefly, the black mulberry juice was put in 10-L fermentation tanks at 20°C with a stable atmosphere in a dark room. The fermentation method consisted of the free fermentation produced by the native yeast present in the black mulberry juice.

From each of the products, three samples were tested. Samples of fruits were identified as MN (*Morus nigra*) and appropriate numbers.

11.2.2. Free radical scavenging activity

Free radical scavenging activity in fruits and their products was measured by the 2,2-diphenyl-1-picrylhydrazyl (DPPH) method by Brand-Williams et al. [1995]. Amount of 0.1 mL of juice, wine, syrup, liqueur; sample of fruits conserved by honey, jam, compote, and jelly was homogenized in a mortar and 1 g of the blended mass was extracted for 5 min in 100 ml of distilled water, filtrated and after filtration the extract was used for measuring. For the detection of free radical scavenging activity, the extract was mixed with 3.9 mL of DPPH radical (0.025 g was soluble in 96% ethanol and diluted as needed). Absorbance was registered at 515 nm in regular time intervals until the reaction equilibrium was reached (10 minutes) by using a spectrophotometer (Genesys 20 UV-VIS, USA). The DPPH scavenging activity (% inhibition) was calculated.

11.2.3. Total anthocyanin content

Total anthocyanin content in fruits and their products was determined by the pH-differential method as described by Wrolstad [1993]. For the preparation of extract, 1 g of sample was extracted with 40 mL of solvent ethanol: 0.1 M HCl –85: 15%, v:v, centrifuged and the supernatant was used for measuring. The extract of the sample was diluted with buffer and the absorbance was read at 520 and 700 nm with a spectrophotometer (Jasco V-560 UV/VIS, Japan). Content of anthocyanin was calculated in mg^{-1} per dm^{-3} of fresh matter (FM) as pelargonidin-3-glucoside with a molar absorption coefficient of 22400 M^{-1} cm^{-1} and molecular weight of 433.2 Da.

11.2.4. Statistical evaluation

Differences among the tested traits were tested by the ANOVA and Tukey test. Statistical processing of the results was performed using STATISTICA 10 CZ software.

11.3. Results and discussion

Black mulberry is a long-lived attractive tree that can be planted as a specimen in landscaping. Owing to its drought hardiness and low maintenance cost, black mulberry is perfect for edible landscaping. Besides, M. nigra attracts various species of birds that feed on its fruits thereby adding visual interest to the landscapes. The fragile and perishable nature of black mulberry fruits has deterred its commercial cultivation [Ahlawat et al. 2016].

In total, 964 genotypes were identified in cadasters of 27 villages and municipalities of Central and Western Slovakia. The most abundant occurrence was observed in the Tekov region with 845 trees (89%) and 119 trees (11%) in other regions (Table 11.1).

The highest number of trees was found to be in Pukanec cadastre (470) and the surroundings of nearby village Devičany (115). This locality represents the largest Central European concentration of black mulberry trees occurring in one place.

The data are similar with the information reported by Králik and Rosenberger [1994]. Mikuška [2002] identified in Pukanec cadastre 420 mulberry trees and 295 trees in 8 village cadastres (Bátovce, Bohunice, Čajkov, Devičany, Jabloňovce, Pečenice, Rybník nad Hronom, Tekovská Nová Ves) of Tekov region.

Table 11.1. The list of localities with tree ID and number of identified mulberry trees

Locality	Tree ID	Number of trees
Pukanec	M001-M500	470
Devičany	M501-M615	115
Bátovce	M621-M634, M651-M658, M673-M684	34
Bohunice	M759-M810	52

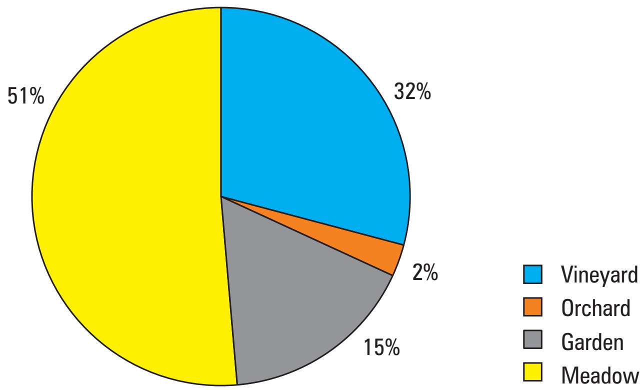
Žemberovce	M685-M731	47
Jabloňovce	M732-M758	27
Gondovo	M811-M820	10
Čajkov	M821-M839, M847-M857, M868-M880	43
Pečenice	M635-M650, M659-M672	30
Rybník	M839-M846, M858-M867	17
Sebechleby	M881-M899	27
Nitra	M900-M912	13
Štitáre	M913-M914	2
Hosťová	M915-M921	7
Pohranice	M922	1
Sabinov	M923	1
Považany	M924-M925	2
Chtelnica	M926-M928	3
Smolenice	M929-M932	4
Horné Orešany	M933-M944	12
Dolné Orešany	M945-M963	19
Doľany	M964-M965	2
Častá	M966-M972	7
Modra	M973-M974	2
Častkov	M975	1
Rovensko	M976-M977	2
Krupina	M363-M368	6
Stredné Plachtince	M369-M372	4
Skalica	M978-M981	4
Total		**964**

* Localities in Tekov region are marked by bold letters

Source: Authors' own study

Black mulberry grows on soils of poor, often stony, permeable, and relatively dry, shallow to medium deep. Andesite and especially proselytized andesite, which form the geological base of the surroundings of Pukanec, are classified from the chemical point of view into the group of silicate rocks, without calcium carbonate. By the analysis of nutrients, andesite rocks, and soils from this area, have formed medium-rich minerals [Králik and Rosenberger 1994].

By our analysis, the registered mulberry genotypes are usually growing as solitary trees in vineyards, on meadows and pastures (Fig. 11.2). The meadows and pastures localities are mostly abandoned vineyards, orchards, and gardens. By Chittendon [1951] mulberry as solitary trees appears highly decorative country elements.

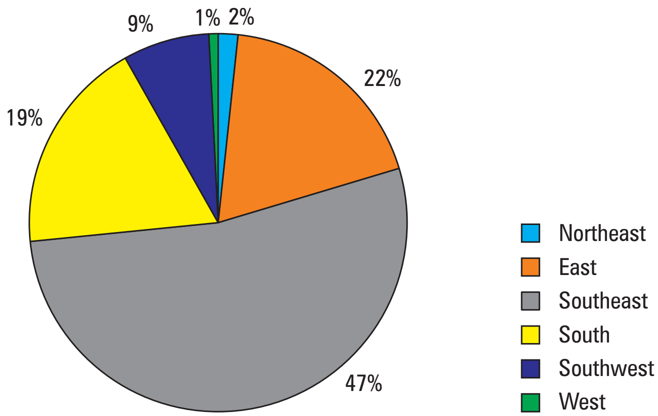


Source: Authors' own study

Fig. 11.2. Share of mulberry localities in Pukanec cadaster

Black mulberry genotypes in Slovakia grow in an altitude range of 146–517 m above the sea level, anyway 40% of trees may be found in the altitude interval of 300–400 m. By Bean [1981] mulberries occupy mostly the southern slopes with sufficient solar radiation. Our analysis confirmed that 88% of mulberry occurrence are southern localities in Pukanec cadastre.

In the Tekov region, black mulberry is closely connected to vineyards. It can only be found in places where the vine (*Vitis vinifera*) is grown intensively or at least in the past [Mikuška 2002]. Such places occur predominantly on the southern slopes of the Štiavnica Mountains. The tradition of winegrowing in Pukanec is hundreds of years old. The vineyards 'Nad Vajrabom' is the richest locality of black mulberry growing. Local wines are classified in the mountain category. The optimal environment for black mulberries in vineyards is changed. This is mainly due to the fact that over the past 30 years the environment has changed, and the traditional winegrowing has been slowly declining. While in the past the training of vines were individual stakes, with a cut on the head and the vineyards were situated in an unfavorable, slope terrain, nowadays new modern vine training techniques prevail. This method is suitable only on flat terrain or on gentle slopes. Otherwise, the vineyard would be difficult to cultivate by machinery and would not be accessible to heavier machines (e.g. tractors). Not all land used for intensive economic exploitation at the previous period still serves for this purpose [Mikuška 2002].



Source: Authors' own study

Fig. 11.3. Position to cardinal points of mulberry localities in Pukanec cadaster

Most villages in the Tekov region have a small population and some are even extinct. Many young people move to the cities for a job and the result is that they leave vineyards abandoned. Therefore, the cultivation not only of traditional fruit species but also of vines is considered declining. In these places, succession and overgrowth of these sites occur. In competition with successive flora, mulberry dies despite its amazing toughness because it is sensitive to lack of sunlight.

Table 11.2. Dimensional parameters of mulberry trees in Pukanec cadastre

Traits	n	Min	Max	$\bar{x}$	v (%)
Tree height (m)	467	1	10	5.16	29.71
Crown width (m)	467	1	16.5	7.55	39.67

Source: Authors' own study

The black mulberry trees in Pukanec cadaster are of height from 1 to10 m and the crown width range from 1.5–16.5 m (Table 11.2). Koyuncu [2004] measured by a selected collection of 6 black mulberry genotypes in Turkey the tree height in the range 9–23 m and the crown width from 7.30 to 17.20 m. Similar results were reported by other authors as well [Reich 1991, Verheij and Coronel 1991, Tutin 1996].

From the total number of evaluated black mulberry genotypes (470) 43% exerted a normal tree shape. The remaining group (57%) of genotypes consisted of trees with the trunk split into two or even more parts, forming a different habitus shape (Fig. 11.4). There could be found interesting shapes and forms representing highly welcomed objects for photographers and nature admirers (Fig. 11.5).

Photo: J. Holecyová

Fig. 11.4. Mulberry tree

Photo: J. Brindza

Fig. 11.5. Mulberry tree with split trunk

In the group of trees with a split trunk, the secondary rooting of branches was observed having contact with soil. Actually, this is an important fact explaining why even the damaged genotypes with split trunks are fully viable and regularly yielding fruits. On the other site by such genotypes, it is more difficult to estimate their age. Anyway, the ability of black mulberry trees to enlarge the root system by the above-described way brings them an advantage of prolonged survival (up to 500 years) with well-preserved fertility (Table 11.3).

Table 11.3. Estimated age and number of trees in Pukanec cadaster

Age (years)	20	30	40	60	80	100	150	200	250	300	350	400	450	500
Number of trees	1	6	1	11	3	37	47	66	48	113	76	38	4	9

Source: Králik, Rosenberger (unpublished) according to Mikuška (2002)

Mikuška [2002] observed in Pukanec cadaster of the total number of 421 trees, 46 young trees under 30 years of age. Of these, 46 were 38 young, planted trees, and 8 grew from the stump of an old, already removed mulberry. Medium age (up to 150 years) was observed in 102 trees. These trees had a compact trunk. The remaining 273 were older trees, which already had a split trunk.

Propagation of this species is quite complicated, which is based on several factors [Kovalovský 1960] and consequently, the black mulberry is becoming an endangered plant in our country. From this, it follows the necessity to secure the in situ preservation of *Morus nigra* L. State of the health of black mulberries in the Slovak population is good. This species is even tolerating the polluted environment reported by Grieve [1984]. Some diseases (*Mycosphaerella arachnoides*) and pests (*Parthenolecanium corni*, *Cossus cossus*, and *Chrysobothris affinis*) are occurring but it is not in mass extent [Mikuška 2002]. Complex study of microflora inhabiting leaves and fruits of black mulberry in Slovakia reported Brindza et al. [2007].

Experimental results of morphometric analyses and the determined quantitative traits variability degree of buds, inflorescences, leaves, and fruits are presented in Table 11.4. These data illustrate differences in the degree of variability of quantitative traits. Low variability degree (variation coefficient value up to 10%) has been found with the male and female inflorescences width. With the rest of the evaluated traits, only middle variability degree has been found (variation coefficient value up to 20%).

Significant differences were found with all traits concerning the leaves. Mulberry genotypes differed in leaves width and length (Table 11.4). In the population were determined leaves with length ranges from 65.7 to 162.4 mm and leaves width of 62.4 to 97.6 mm. Koyuncu [2004] described black mulberries having leaf length from

83.8 to 109.2 cm and width from 82.4 to 101.6 cm. From the comparison of our and Koyuncu data sets definitively follows a high degree of conformity. Moreover, Yaltırık [1988] and Lale [1992] reported similar results.

Table 11.4. Statistical variability indicators of black mulberry (*Morus nigra* L.) population in Pukanec cadastre

Traits	n	Min	Max	$\bar{x}$	v (%)
Male inflorescence length (mm)	81	14.82	37.22	25.04	15.73
Male inflorescence width (mm)	81	5.34	8.1	6.53	8.61
Female inflorescence length (mm)	83	8.4	16.28	11.89	13.28
Female inflorescence width (mm)	83	5.2	8.74	7.11	9.72
Main bud length (mm)	338	3.78	10.34	7.05	16.18
Main bud width (mm)	337	1.28	6.16	4.17	17.30
Main bud thickness (mm)	335	1.25	5.64	3.91	18.88
Side bud length (mm)	338	2.9	9.69	6.28	17.09
Side bud width (mm)	338	0.87	5.08	3.56	18.71
Side bud thickness (mm)	338	0.51	4.65	3.00	18.71
Leaf length (mm)	458	78.93	185.33	122.01	16.05
Blade of leaf length (mm)	458	65.73	162.37	104.99	16.70
Blade of leaf width (mm)	458	62.40	157.70	97.62	15.73
Distance of leaf lobes (mm)	458	6.00	25.14	11.9	30.47
Stem leaf length (mm)	458	11.57	31.96	20.65	15.39
Fruits length (mm)	461	10.70	27.20	19.92	11.59
Fruits width (mm)	461	9.20	16.30	13.18	7.44

Source: Authors' own study

Minamizawa [1997] distinguishes five basic forms of black mulberry leaves: orbicular, elliptical, cordate, and ovate a lanceolate, which were found in Slovak populations of black mulberry genotypes as well. The most frequently occurring genotypes had the cordate leaf shape. Many authors confirmed the prevailing occurrence of cordate leaf forms [Yaltırık 1988, Lale 1992, Tutin 1996, Koyuncu 2004].

The trees are mostly monoecious, the flowers are bisexual and they are developed simultaneously with the leaves. The mulberry blooms in mid-May. Male flowers grow mostly alone on one or more branches. This phenomenon resembles partially dioecious plants. In a study of 470 genotypes in the cadastre of Pukanec, it was found that some trees are dioecious with female blossoms, and even trees that were treated with rejuvenation cut produced only female flowers [Holecyova and Brindza 2006].

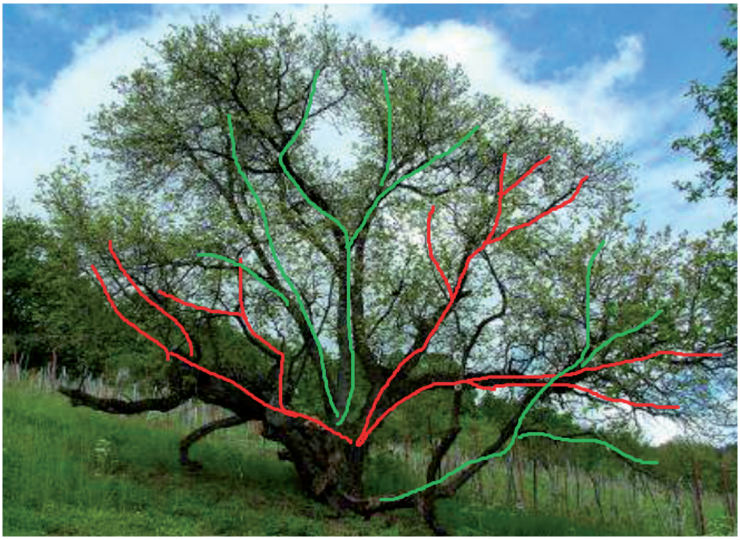


Photo: J. Holecyová

Fig. 11.6. Partially dioecious mulberry tree, green color branches with male flowers, red color branches with female flowers

In autumn, the branches with male flowers have green leaves and fall later than the leaves with female flowers that are yellow and rather fall off. This is probably due to higher nutritional and maturation requirements for female branches [Holecyova 2007].

Fruits of black mulberry are the most important mulberry product. In the experimentally evaluated population were observed fruits with distinct differences in their shape, size, and color (Fig. 11.7). From the botanical point of view, the mulberry fruit is a tiny key fruit closed in a fleshy corolla [Toman 2003].

Tested mulberry genotypes showed distinct differences in fruit length, width, and weight as well. In Table 11.5 are selected genotypes with the lowest and the highest values of tested parameters. Measured ranges for average fruit length represented 10.7–27.2 mm and for fruit weight 0.5–16.3 g. Data published by Koyuncu [2004] for fruit length-weight were in the range 22.33–25.15 mm and 3.11–4.49 g, respectively.

Photo: J. Holecyová

Fig. 11.7. Mulberry fruits variability (Tree ID from left: M013, M005, M198, M410)

Table 11.5. Variability of selected fruit traits of black mulberry (*Morus nigra* L.) genotypes

Genotypes with the lowest values						Genotypes with the highest values					
Genotype	n	Min	Max	$\bar{x}$	v%	Genotype	n	Min	Max	$\bar{x}$	v%
Fruits weight (g)											
M429	30	0.35	1.15	0.50	26.67	M476	30	9.17	21.69	16.3	12.81
M468	30	0.69	2.193	0.83	30.12	M393	30	10.41	19.12	15.7	9.25
M409	30	0.71	2.52	0.93	32.44	M172	30	11.28	19.41	15.6	8.69
Fruits length (mm)											
M468	30	7.22	15.25	10.70	12.51	M113	30	22.93	39.50	27.20	10.12
M409	30	7.58	16.23	12.90	11.18	M491	30	22.85	32.56	26.90	18.14

M268	30	10.25	16.75	13.70	23.72	M393	30	21.25	31.16	26.30	18.52
Fruits width (mm)											
M468	30	6.53	13.76	9.20	13.7	M476	30	12.41	22.16	16.30	9.97
M477	30	8.85	16.10	11.85	10.1	M113	30	10.91	21.5	15.70	10.8
M409	30	7.25	15.38	10.41	13.02	M478	30	11.87	19.21	15.60	7.84

Source: Authors' own study

Fruits are maturing from middle July up to September (Fig. 11.8). When are red, the fruits are very sour, but during the maturation process, the acid substances are lowered and in full maturity, the fruit is sweet, just with a slight acidity, having a characteristic odor and high amount of blood-red juice. Fruits could be freely torn from the branches only when fully matured [Králik and Rosenberger 1994]. In the climatic condition of Slovakia, the fruits of black mulberry are ripening in the period from the end of July up to the start of September. This prolonged fruit maturation period is highly suitable from the point of their picking and processing by the local population. In Turkey situated southwards from our country, the picking period is longer starting from the middle of June until the end of September [Koyuncu 2004].

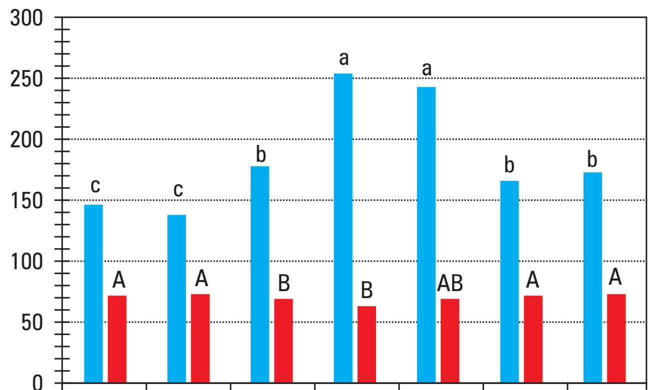
Photo: J. Brindza

Fig. 11.8. The gradual ripening of the black mulberry fruits

11.3.1. Content of anthocyanin and free radical scavenging activity in black mulberry fruit

M. nigra exhibited a wide spectrum of biological and pharmacological therapeutic effects including anti-inflammatory, antimicrobial, anti-melanogenic, antidiabetic, anti-obesity, anti-hyperlipidemic, and anticancer activities. *M. nigra* also showed protective effects against various human organs and systems, mainly based on its antioxidant capacity. These findings strongly suggest that *M. nigra* can be used as a promising nutraceutical resource to control and prevent various chronic diseases [Lim and Choi 2019].

In analyzed samples of Kamiloglu et al. [2013], chlorogenic acid, rutin, and cyanidin-3-O-glucoside were confirmed as the major phenolic acid, flavonol, and anthocyanin, respectively. In general, fresh mulberry showed higher contents of total phenolics (0.49–57 fold higher), flavonoids (0.02–162 fold higher), anthocyanins (6–12209 fold higher) and antioxidant capacity (0.72–691 fold higher) compared to other products. Total flavonoids and phenolics showed a linear relationship with antioxidant capacity, indicating that flavonoids and phenolics were the major contributors to the antioxidant capacity.



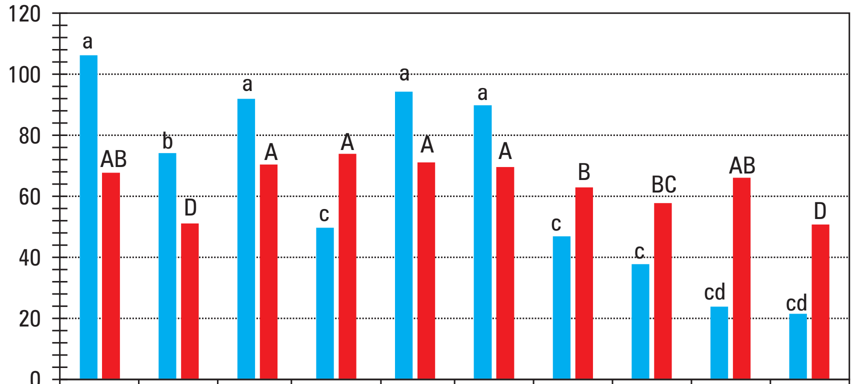
	MN-1	MN-2	MN-26	MN-14	MN-31	Mn-6	MN-17
Anthocyanins	146.3	138	178	254	243	166	173
Inhibition	71.79	72.92	68.95	63	69	71.68	72.83

ab (anthocyanins), A,B (inhibition) means within a column with the same letters are not significantly different according to Tukey's multiple range test ($P \leq 0.05$)

Source: Authors' own study

Fig. 11.9. Anthocyanin content ($mg \cdot dm^{-3}$) and free radical scavenging activity (inhibition in %) in black mulberry fruits

In tested fruit samples the anthocyanins content (Fig. 11.9) ranged from 138.0 to 254.0 mg · dm^{-3}. Differences among the genotypes were significant. Detection of free radical scavenging activity showed a strong effect of black mulberry fruit to eliminate the synthetic radical with values ranged from 63.00 to 72.92%. Our results also showed that there was no correlation found between the anthocyanin content and free radical scavenging activity. Our study confirms that the fruit is a valuable source of natural antioxidants; however, instability during the processing and storage must be taken into account.



	Natural juice	Juice by the hot steam	Fruits in honey	Sterilized fruits in honey	Jam	Jelly	Syrup	Liquer	Canned fruit	Wine
Anthocyanins	106,4	74,3	92,1	49,7	94,5	90	46,9	37,7	23,8	21,4
Inhibition	67,83	51,17	70,46	74,02	71,22	69,67	62,99	57,87	66,16	50,81

ab (anthocyanins), A,B (inhibition) means within a column with the same letters are not significantly different according to Tukey's multiple range test ($P \leq 0.05$)

Source: Authors' own study

Fig. 11.10. Anthocyanin content and free radical scavenging activity (inhibition in %) in traditional black mulberry food products

11.3.2. Anthocyanin content and free radical scavenging activity in black mulberry food products

Mulberry plants belonging to the Moraceae family have been grown for the purpose of being the raw materials for the preparation of jams, marmalades, types of vinegars, juices, wines, and cosmetics [Lim and Choi 2019].

In our black mulberry-derived food products the anthocyanin content ranged from 21.4 mg · dm^{-3} in wine to 106.4 mg · dm^{-3} in fresh juice (Fig. 11.10). Thermal processing strongly affected the products resulting in a lower concentration of anthocyanin, in juice produced by steam it decreased from 106.4 to 74.3 mg · dm^{-3}, after sterilization of fruits in honey the decrease from 92.1 to 49.7 mg · dm^{-3} was observed. In the case of syrup, the final content was 46.9 mg · dm^{-3} in liqueur 37.7 mg · dm^{-3} and/or in compote (canned fruit) 23.8 mg · dm^{-3}, and the differences in the content of anthocyanin among the raw material and processed products were significant ($P < 0.05$).

Important is to point out that the jam and jelly contained 94.5 mg · dm^{-3} and 90.0 mg · dm^{-3}. In these products, the content of anthocyanins changed relatively to less extent and this could be explained by an extreme juice thickening due to water evaporation. Free radical scavenging activity in black mulberry food products (Fig. 11.10) ranged from 50.81% in berry wine to 74.02% in sterilized fruits in honey. A high level of free radical scavenging activity in fruit in honey is strongly influenced by honey, which is rich in antioxidant effects and also in antimicrobial activity. The results confirmed that the traditional technologies applied by inhabitants of Slovakia enabled to keep the high nutritional quality of fruits as well as of food products, what is connected with their beneficial phytotherapeutic effects [Kucelova et al. 2016].

In our other work [Brindza et al. 2013] 16 food products were prepared: juice mixed with cream, yogurt, and/or curd (in several proportions) and 3 confectionery products. Sensorial analyses showed significant differences among tested products. In the group of confectionery products was generally preferred the cream-mulberry cake. High values of antioxidative activity have been measured in the chocolate cake with a mulberry jam (36.90–28.43%), followed by the cream-mulberry cake (29.78–12.71%) and the fresh mulberry juice (30.97–20.17%). The antioxidant activities exerted generally higher values with the samples tested in water, compared to those prepared in ethanol extract.

11.4. Conclusions

Black mulberry (*Morus nigra* L.) is considered to be one of the symbols of Pukanec village (including crafts such as wheelwrights, pottery, and mining). Monitoring and inventory in 27 villages across Western and Central Slovakia resulted in localization of 964 black mulberry genotypes of which 845 trees in the Tekov region. Tekov has the highest occurrence of black mulberry in Slovakia. Usually, these are older trees, but we can also find young individuals. Mulberry can be found mostly in the altitude interval of 300 to 400 m and orientation to southern slopes. They grow mainly in the vineyards area, along with other fruit species. More than half of black mulberry genotypes have the trunk split into two or more parts. At many genotypes, with a split trunk, it was observed the secondary rooting of branches contacting the soil. Owing to trunk splitting it is quite difficult to identify the age of the tree. A prevailing number of trees is old with age between 200 to 500 years. New planting of black mulberry is rare, although mulberry cultivation is becoming increasingly popular. Vegetative as well as generative propagation is common, though the mortality of young individuals is high. The existing black mulberry population in Slovakia territory is interesting and valuable, as it is shown by the variability documented for traits of trees, buds, flowers, leaves, and fruits.

The existing black mulberry population is adapted to the conditions of Slovakia, which is connected with several specific biological particularities. The population has several specific traits like longevity, rapid growth, tolerance to droughts, ability to grow on infertile and rocky soil, resistance to cold and edible fruits. The fruits of black mulberry are a valuable source of antioxidants and anthocyanins. The reduction of anthocyanin content and the antioxidant activity in some food products is caused by the thermal processing of fruits and/or juices. Anyway, black mulberry can be interesting the raw material for the preparation of jams, marmalades, vinegars, juices, wines, etc.

Based on the black mulberry population importance in the Tekov region was created conditions for sustainable use as an alternative species and source for a different application not only in human nutrition but also in medicine and landscaping. Thanks to the occurrence of the largest mulberry population in Central Europe, the Tekov region with heterogeneous landscape structure, favorable climatic conditions, and strong tradition in viticulture has the good potential for further development in the field of rural tourism.

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12

Plums as the South Moravian region indicator

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Abstract. Fruit production has a very long tradition in the Czech Republic. The first mention of fruit growing dates back to the Middle Ages. The first fruit orchards were established in the 17th century. In the 18th century, the first fruits associations were organized and since the 19th century, the intensive development of fruit growing began. Plum trees have been the most widespread fruit trees grown in the Czech Republic. At the beginning of intensive cultivation, plum trees represented a quarter of fruit trees. A significant decrease (about 60%) of plum growing occurred in 80 years when the plum pox virus spread rapidly. Nowadays, there is a demand for cultivars that are nutritionally valuable and disease resistant. The plums are intended for direct consumption as fresh and also for industrial processing. The basic technological processing of plums includes drying, cooking, freezing, preserving, and distilling. These processes have evolved considerably over time. Traditional plum products include dried plums, plum jam, plum dumplings, cakes, and spirits.

Keywords: plums • varieties • nutrition • cuisine • meal

12.1. Introduction

Plum trees are native temperate zone fruit trees. Consumers already in the past selected local individuals that had high-quality taste and growth characteristics. In the Carpathian region, plums had been grown since the 8th century [Kuca et al. 1992]. As plant breeders made progress in improving quality and productivity, primitive varieties were replaced by newly bred hybrids that are more suitable for modern ways of growing [Okie and Ramming 1999]. More than 6,000 plum cultivars are grown in the world, derived from 19–40 botanical species [Hedrick 1911, Rehder 1945, Blažek 2007]. Despite their great diversity, only two plum species predominate in modern plantings, namely *Prunus salicina* Lindl. and *Prunus domestica* L. [Okie and Weinberger 1996].

From a pomological point of view, Kutina et al. classify plum species (P. *domestica* L.) as follows:

- P. *domestica* L., subsp. *insititia* – which includes yellow plums (var. *pomariorum*),
- P. *domestica* L., subsp. *syriaca* – which includes Mirabelles (var. *cerea*),
- P. *domestica* L., subsp. *italica* – which includes rounded renclode (var. *claudiana*) and egg-shaped (oval) renclodes (var. *ovoidea*),
- P. *domestica* L., subsp. *oeconomica* – which includes varieties *pruneauliana* and *mammilaris* [Kutina et al. 1991].

In total, 3,530 plums and prunes are included in the current European Prunus (EP) database. However, Blažek [2007] draws attention to possible duplicates of varieties in the database. Research and Breeding Institute of Pomology – Holovousy (Czech Republic) registers 128 varieties of plum trees and prune trees.

12.1.1. Plums varieties

In the Czech Republic, the old plum varieties include 'Althanova rengloda' (Fig. 12.1), Anna Späth', 'Bühlská', 'Černošická', 'Durancie', 'Hamanova', 'Chrudimská', 'Kirkeho', 'Královna Viktorie', 'Malvazinka', 'Mirabelka flottowa', 'Mirabelka nancyská', 'Ontario', 'Oulinská', 'Stanley', 'Švestka domácí', 'Vlaška', 'Wangenheimova, švestka', 'Wazonova', 'Žlutý špendlík' (Fig. 12.2), 'Zelená rengloda' (renclodes) [Lokoč et al. 2011].

Non-profit organizations are involved in mapping old varieties and their preservation. The largest association is the Czech Union for Nature Conservation (ČSOP) founded in 1979. The varieties that have been found and identified are registered in the database managed by the ČSOP (The Basic Organization of ČSOP Meluzína). Production quantities and yields of plums and sloes in the world and the Czech Republic are presented in Figures 12.3 and 12.4.

Photo: J. Sedlák

Fig. 12.1. Althanova rengloda

Photo: J. Sedlák

Fig. 12.2. Žlutý špendlík

Currently, plums more resistant to sharka viral disease (plum pox) are grown more frequently [Richter 2004]. From the original varieties, the resistant representative of *P. domestica* L., subsp. *insititia*, includes the varieties 'Stanley', 'Wangenheimova, švestka'. The group *P. domestica* L., subsp. *italica* – which includes the varieties: 'Wazonova', 'Zelená rengloda', 'Althanova rengloda'. The sharka-resistant varieties of the group *P. domestica* L., subsp. *syriaca*, include 'Mirabelka nancyská'.

The 'Stanley' variety is originally from the USA. The tree is of a medium size, with a semi-upright growth habit. The flower is medium- to large-sized. The fruit is large, elliptical and dark blue. The pulp is yellowish-green, tough and medium-juicy.

The 'Wangenheimova, švestka' variety comes from Germany where it originated as a random seedling. The tree is of a lush growth with a semi-upright growth habit. The flower is medium to large. The fruit is small- to medium-sized, symmetrically elliptical. The colour of the fruit is violet blue. The pulp is yellow-dark green, medium-juicy.

The 'Wazon' variety ranks among the renclodes. Originally it comes from France. The tree is of a medium-lush to lush growth; it has an extending to overhanging growth habit. The flower is medium- to large-sized. The fruit is medium- to large-sized, symmetrically circular. The colour of the fruit is yellow, on the sunny side with a reddish-purple tint. The pulp is yellow in colour, medium to very juicy, sweet and aromatic.

The 'zelená rengloda' variety ranks among the renclodes. Originally it comes from France. The tree is of a medium-lush to lush growth, a semi-upright growth habit. The fruit is medium- to large-sized, symmetrically circular. The fruit colour is green without the opaque colour on the sunny side. The pulp is green, medium to very juicy, sweet and very aromatic.

The 'Althanova rengloda' variety ranks among the renclodes. It is a Czech original variety formed as a seedling of the 'zelená rengloda' variety. The tree is of a medium-lush to lush growth, with a semi-upright to upright growth habit. The flower is medium-sized. The fruit is medium-sized, circular, and asymmetric. The pulp is yellow, very juicy, sweet and aromatic.

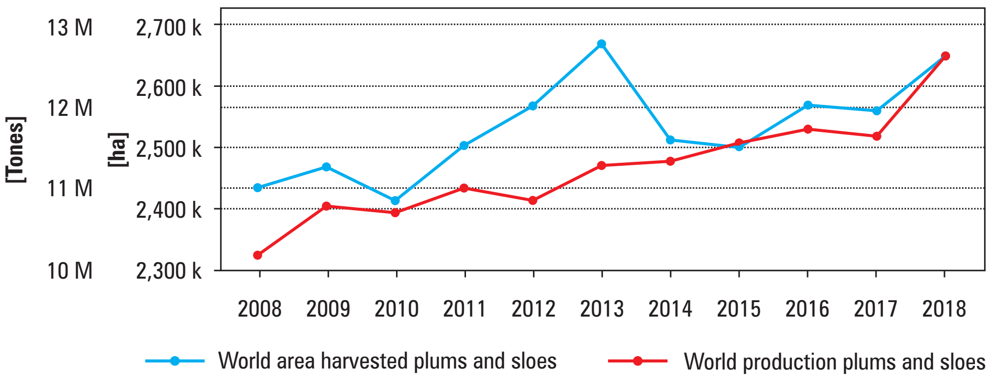
The 'mirabelka nancyská' variety ranks among the Mirabelles. Originally it comes from France. The tree is of a medium-lush growth, with a semi-upright growth habit. The flower is small- to medium-sized. The fruit is very small, spherically symmetrical. The fruit colour is yellow. The pulp is also yellow, medium-juicy and aromatic [Tomáš 2011].

Plum trees are demanding concerning their habitats. They have higher demands for soil and air humidity. They require warmer locations up to an altitude of 350 metres above sea level. The average annual temperature should be above 8°C, average annual rainfall 500–700 mm. The recommended cultivation shapes are a medium rootstock, spacing 6–7 m × 4–5 m, or a pyramid dwarf tree, spacing 4.5–5 m × 2–3 m [Čepička 2004]. In human diet, plums are a nutritionally important fruit. They are also an important source of compounds influencing human health and preventing the occurrence of many diseases [Stacewicz-Sapuntzakis et al. 2001]. The important bioactive compounds include flavonoids, anthocyanins, carotenes and polyphenolic acids, which contribute to a strong antioxidant capacity of their fruit [Vinson et al. 2001]. Differences in polyphenol content and antioxidant activities have been demonstrated both between individual varieties [Tomič et al. 2019] and between traditional and new varieties [Rop at al. 2009].

In some areas, 'prunes' means a dried product; elsewhere, the term also covers fresh fruit. Prunes (dried) are produced by industrial drying of plums at 85–90°C for a period of 18 hours. It is believed that this process originated thousands of years ago near the Caspian Sea – a region where European plums were discovered [Igwe and Charlton 2016].

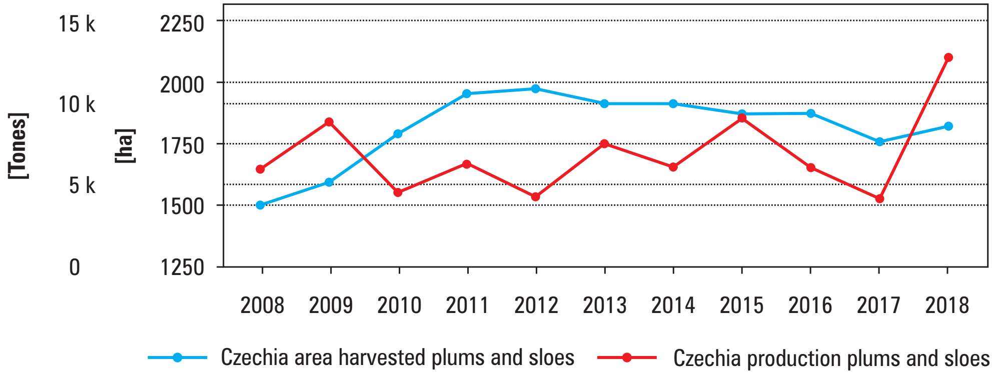
Plums are an excellent source of nutrients [Cao et al. 1997] and are also an important source of compounds influencing human health and preventing the occurrence of many diseases [Stacewicz-Sapuntzakis et al. 2001].

Dried prunes are known for the laxative effect attributed to the fibre content. These effects are probably also influenced by the content of phenols (e.g. chlorogenic acid) and sorbitol [Tinker et al. 1991]. They have a high fibre content (6 g/100 g) including hemicellulose (3.0 g/100 g), pectin (2.1 g/100 g) and cellulose (0.9 g/100 g) [Stacewicz-Sapuntzakis et al. 2001]. Several studies have shown that dried prunes are also a rich source of polyphenol derivatives including neochlorogenic acid, cryptochlorogenic and oligomeric proanthocyanidin [Chok and Lang 1961, Reele and Chodos 1985]. The total content of phenols in various plum cultivars was recorded between 282–922 mg/100 g of fruit [Siddiq 2006]. Due to their lower fat content and significant amounts of important nutrients, such as carbohydrates, vitamins, and minerals, they are considered to be beneficial to human health.



Source: FAO [2019]

Fig. 12.3. Production quantities/Yield of plums and sloes in the world + (Total)



Source: FAO [2019]

Fig. 12.4. Production quantities/Yield of plums and sloes in the Czech Republic

12.1.2. Plums as part of meals in the Czech and Moravian folk cuisine

In terms of fruit trees, the findings of carbonized plant residues in Slavic settlements from the 6–7th centuries in the Czech lands included wood only from plum trees [Váňa 1983]. The original home of plum trees in Asia. Plum trees were cultivated in Syria and grafted by the Romans who used to preserve the plums by drying [Larousse 2009].

In Otto's Encyclopaedia, Prunus domestica is mentioned as the most important type of stone fruit in Bohemia and Moravia [Otto 2001]. At present, the use of plums is mostly tied to sweet foods such as different kinds of cakes, fruit dumplings, or cereal porridge. However, in the past in folk cuisine, plums were used as a common ingredient in some soups or sauces that constituted part of meat dishes.

Generally, fruits are foods with a short shelf life that are subject to relatively rapid microbial spoilage (especially by the effect of fungi and yeasts); endogenous enzymes can constitute another reason for spoilage. Our ancestors dealt with the issue of plum shelf life in two ways. The first way was drying when the loss of water decreased water activity; this then prevented microbial growth and manifestations of the metabolic activity. The second way was the preparation of plum jam. This process involves conservation based on the principle of evaporative thickening [Kyzlink 1980]. Thanks to the sufficient amount of sugar and fruit organic acids, their concentration also brings about protection against the activity of its endogenous enzymes. Long-term exposure to temperatures around 100°C is also affected. In the case of plum jam, the concentrated puree is obtained with 55–60% of dry matter

[Kyzlink 1980]. The procedure for the preparation of plum jam is described by Hošková and Chalupová [2015]: Place well-ripened plums with stones in a copper pot and cook for 24 hours. Stir the mixture continuously to prevent the plums from burning. Pass the cooked fruits through a sieve (by this, you will get rid of the stones) and return to the pot. This mass used to be called 'kynkule' [Otto 2000]. Boil until the plum jam turns brown. To produce one pot of thick plum jam, three pots of stoned cooked mass were needed. In this way, the shelf life of plums was ensured by the inactivation of endogenous enzymes, by thermal devitalization of microorganisms present, and also by the reduction of water activity due to the evaporation of a considerable portion of water.

Since the preparation of plum jam was extremely time-consuming, it was carried out 'centrally' in the past in rural areas or smaller towns – in households specialized in this activity. According to Otto's Encyclopaedia from the beginning of the 20th century, usually, 5 back baskets of plums fitted in a plum-jam copper cauldron [Otto 2000]. For heating, wood was used; since 1908, you could find references to steam heating in the literature. The puree obtained by cooking the plums had to be stirred all the time to avoid its burning. For this purpose, a special wooden stirrer was used in the form of a vertical shaft with a lower wider bar cut out according to the shape of the cauldron. The stirrer was called 'vašek'. The cauldron operator, who would also put wood on the fire, kept moving 'vašek' back and forth with the help of a long pulling rod. For more extensive production, machine stirring was often used, which significantly reduced the burning of plum jam (Fig. 12.5). The finished plum jam was filled into earthenware pots or wooden barrels [Otto 2000]. In small productions, the plum jam was filled into mugs and the air was pushed out of them in the oven. The crust formed on the surface was covered with canvas or suction paper soaked in rum or alcohol. One gram of salicylic acid was added to 20 g of alcohol. In some areas of the Czech Republic, they used to cover the plum jam with a thin layer of pitch [Večer 1908]. The finer light plum jam was produced by soaking plums in water until the peel broke. The plums were then moved to cold water to remove the skin and the stone. After these steps, the plums were preserved in a traditional way [Večer 1908].

The traditional method of plum processing also includes the production of plum preserves ('marmeláda'). Preserves are made from the peeled stoned pulp by boiling it until soft and adding sugar. For the originally grown varieties of sour plums and greengages, 750g of sugar per 1 kg of fruit is used. Crushed cinnamon, nutmeg, and lemon juice can be added to flavour the preserves.

In addition to preservation, the plum jam was also traditionally processed by drying. A fresh butter-greased paper with raised edges was placed on a baking tray or a hurdle. A 10 cm thick layer of the plum jam was spread onto the paper and dried in a dryer. After one side had dried, the plum jam layer was turned and dried again. Traditional plum pastes were thus obtained [Večer 1908].

Source: Večer [1908]

Fig. 12.5. Cauldron for cooking plum jam with its own firebox and stirrer

Dried prunes and plum jam constituted part of many recipes in folk cuisine, especially in the Moravia region.

12.1.2.1. Moravian soups with plums

The 'Haná' cabbage soup with mushrooms is made of 100 g of dried prunes per 250 g of sauerkraut [Faktor and Žantovská 2017]. Cover cut sauerkraut with water and boil with bay leaves until semi-soft. Stew 20 g of dried mushrooms and the stoned plums in a small amount of water. Mix everything, prepare a paprika base (onion fried briefly on hot lard with ground paprika); add flour mixed in milk. Cook everything until tender. Finally, add a Moravian sausage cut into thin slices and refine the soup with cream.

Wallachian 'ščedračka' is another soup with dried prunes. Soak dried peas overnight (100 g of peas for 4 portion) and cook until tender. Cook 50 g of dried prunes and 50 g of dried pears in 1 l of slightly salted water until tender. Strain the soup; squeeze the cooked peas, plums and pears into the soup through a sieve (or mix with a hand mixer). Add a handful of sliced dried mushrooms soaked in water and cook for a while [Faktor and Žantovská 2017].

Soup called 'moczka' comes from the Silesia region; it was prepared by the local Poles there. For 4 portions, this soup with unusual composition requires: 300 g dried prunes, 300 g honey gingerbread, a medium-sized parsley, celery, 2 bottles of dark beer, 10 dried figs, 50 g walnut kernels, 100 g raisins, 20 g almonds and 1 lemon juice. Soak prunes in lukewarm water for 4 hours. Cook the vegetables until tender and then remove them from the broth; dip the gingerbread cut into small pieces into the broth. Add the beer. Cook the prunes and pour them on the gingerbread; add raisins, chopped nuts and figs. Add salt and lemon juice. Make a light roux, add it to the soup and cook briefly. Serve the finished soup, hot or cold, in small bowls [Faktor and Žantovská 2017].

12.1.2.2. Prune sauces

Prunes and plum jam (both ingredients were usually used in a single recipe) were used for the preparation of sauces to thicken and give the sauce a taste and a dark colour. A simple plum jam sauce from Moravian Haná is described by Hošková and Chalupová [2015]: Boil bread in water until soft. Put plum jam in the pot, cover with water and boil. Add the overcooked bread, amount of sugar according to your preferences, vinegar, possibly wine, a little of cinnamon, and rum. The so-called 'trnčenica' or 'trnčená máčka' originates from the same area. It is served with smoked meat and yeast or potato dumplings. For 4 portions, you need 2 handfuls of dried prunes, 2–3 tablespoons of plum jam, cloves, allspice, and lemon zest. Cook washed prunes in water with spices and sugar. Boil the plum jam separately with a little water and cream (150 ml) with an added tablespoon of fine flour mixed in it. Pour everything together with mixed boiled prunes; season with salt and sugar. Pour the sauce over portions of sliced warm smoked meat [Faktor and Žantovská 2017].

Silesian Germans and Czechs used to make the so-called 'šimlovice'. Dried prunes and plum jam were also used: Pour beef broth over light roux; add plum jam (80 g/4 portions), dried prunes (20 g), and cinnamon; whisk the mixture and boil it for 30 minutes. Finally, add milk and sweeten the sauce. Serve with smoked boneless knee and potato dumplings.

Plum sauces made of plum jam and dried prunes were known throughout Bohemia and Moravia; they were served with smoked pork. In neighbouring Austria, plum sauces were not used in traditional cuisine [Paukertová 1993].

12.1.2.3. Desserts

One of the most famous Czech dishes in Austria-Hungary in the 19th century included plum dumplings. Some manor recipes for dumplings stuffed with fruits date already from the beginning of the 17th century [Faktor and Žantovská 2017]. The dumplings were made of different doughs or pastes, sometimes with potatoes, semolina, or bread, using different technologies. As for toppings, butter or cream were used, and especially in Moravia, they were sprinkled with poppy seeds. In different regions, plum dumplings had different names; for example, 'obálky' or 'kulivále'. Since housewives and housekeepers had also other work to do in the households in addition to cooking and food preparation, they did not have time to spend too long preparing plum dumplings. That's why they used to make them really big, putting three to five peeled plums in one dumpling. After cooking, they cut the dumplings into smaller pieces, put them on a bowl, greased and sprinkled with cottage cheese. In winter, dumplings were made from dried prunes, which were cooked or at least steamed briefly in advance [Faktor and Žantovská 2017].

In the region of Haná, potato pasties with plum jam are made. The supple and flexible paste is prepared from boiled and chilled potatoes, eggs, and semi-coarse flour. Roll the paste flat, cut into squares, and put a teaspoon of plum jam in the centre. Fold the sides of the squares and squeeze them together to prevent leaks of the plum jam. Cook in salted water with a hint of flour to prevent the pasties from becoming slimy. As soon as they float to the surface, they are ready. Sprinkle with sugar, ground poppy seeds, gingerbread, or fried breadcrumbs on the plate and pour melted butter over them [Hošková and Chalupová 2015]. However, plum jam pasties can also be made from wheat coarse flour, as stated by Vrabec [1970]: Prepare classic noodle paste (350 g coarse flour, 2 eggs, 0.1 l water); after a short rest, roll the paste flat into squares with sides of about 9 cm. Place a teaspoon of plum jam in the centre of each square, smear the edges with egg white, fold the squares in half, squeeze the edges together and cook the pasties in salted boiling water for about 8 minutes. Drain the pasties, put on the plates, pour melted butter over them with fried breadcrumbs, and sprinkle with sugar.

In Slovakia, they prepare plum jam pies with poppy seeds in a similar way. Use coarse flour, eggs, and water to make a stiffer paste; roll it flat to the thickness of about 2 mm. Put scoops of plum jam on half of the flat-rolled paste; cover with the second half. Press the pastedown around the plum jam, cut with a special paste cutter, and cook in water. Pour melted butter on the cooked pies and sprinkle them with ground poppy seeds and sugar [Szemesová 2010].

A Christmas prune sauce comes from Moravia. Wash the dried prunes (200 g/4 portions) and boil them for 10 minutes in water with two slices of lemon with zest, a piece of whole cinnamon, 5 cloves, and a piece of star anise. Strain, stone the prunes, slice and return to the liquid. Add the nuts (walnuts and hazelnuts, peeled almonds, 2 heaped spoons of each), a spoonful of raisins, cut figs, and one sachet of vanilla sugar. To make it thicker, add about 2 tablespoons of grated gingerbread. Cook over low heat for 20 minutes. Serve the sauce warm, lukewarm or cold, alone or with a Christmas cake [Faktor and Žantovská 2017].

Plum jam is also a must in the Haná cakes. Make semi-stiff dough from fine flour, sugar, yeast, oil, lemon zest, and egg yolks; leave it to rise. Then divide it into 4 parts, and roll each part flat. Wrap one-quarter of curd filling (soft curd, caster sugar, egg yolks, raisins, and lemon zest) in each of the flat parts and roll out a thick cake of 25 cm in diameter. Spread the surface with plum jam, sprinkle with crumbs (made of the same portion of butter, caster sugar, and fine flour) and bake in a slightly heated oven [Faktor and Žantovská 2017]. The so-called 'plum jam souls' come from the same area. Prepare a medium-stiff yeast dough. Cut pieces from the risen dough using a spoon; spread each piece with your fingers to make a small cake. Put a teaspoon of plum jam in the centre and wrap nicely. Place the 'souls' on the greased baking tray close to each other. Grease each 'soul' on all sides with melted lard. This will prevent the cakes from sticking to each other [Hošková and Chalupová 2015]. Bake them until they reach a light brown colour. Separate the 'souls' from each other and richly sprinkle with sugar on a plate; the 'souls' have brown tops and white sides.

12.2. Conclusions

The Czech Republic has a long tradition of fruit production. The region of South Moravia has excellent prerequisites for fruit-growing activities. The most widespread fruit trees grown in the region includes plums. Plums are an excellent source of nutrients and compounds that affect human health and prevent many diseases. Plums can be eaten fresh as well as industrially processed. In the past in folk cuisine, plums were used as a common ingredient in some soups or sauces that constituted part of meat dishes. At present, the use of plums is mostly tied to sweet foods such as different kinds of cakes, fruit dumplings, or cereal porridge. Traditional plum products in the region South Moravia include dried plums, plum jam, plum dumplings, cakes, and spirits.

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13

Tokaj – European winery gem in Slovakia

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Abstract. Tokaj is an exceptional wine-growing region in the heart of Europe located in two countries: Hungary and Slovakia. The Tokaj area is one of the oldest legislative delineations in the world, as it was clearly defined and closed in 1737 by the royal decree of Charles III, and the Tokaj wine could only be grown and finished in the 21 sites listed in the decree. During Austria-Hungary, respectively, Hungary was a Tokaj uniform. After the First World War and the establishment of Czechoslovakia and 'Trianon', the state border divided this region into the Hungarian and Slovak part. Slovakia received a smaller part, representing only 10% of the total area of Tokaj vineyards. The Tokaj wine-growing area represents in Slovakia a closed wine-growing area bordered by cadastral territories of seven Tokaj villages and has an area of 907 ha. The oldest wine-growing village is Malá Tŕňa, which belongs to the original Tokaj villages defined in the decree in 1737. The varietal wines or typical Tokaj wines, mainly natural sweet wines made from a mixture of three Tokaj grape varieties: Furmint, Lipovina, and Yellow Muscat are produced in the Slovak part of Tokaj. Tokaj special wines are typical oxidative, maturing in 136 L barrels with oxygen access under a layer of skin-forming yeast called for in Tokaj tuf cellars.

Keywords: cibebas • special Tokaj wines • Tokaj selection

13.1. Introduction

The development and growth of a country require the growth of regions in areas that are specific. Regional specialties are also specific and need to be properly managed to help the region's tourism. The Tokaj wine region has a high potential in the area of viticulture and winemaking. Tokaj wine region is considered exceptional in terms of the exceptional value of the territory and the production of special wine and belongs to the category of the natural and cultural heritage of Slovakia, but also of Europe. It represents a combination of the use of natural resources and landscape conditions by a man in providing original products. To preserve the classic technology of wine production, integrated protection and enhancement of this area is needed.

Tokaj is an exceptional wine-growing region in the heart of Europe located in two countries: Hungary (5800 ha) and Slovakia (929 ha). In Slovakia, Tokaj is located in its south-eastern part and in Hungary in the north-eastern part of the territory in the Bodrog basin. In the northern part the border represents Zemplinske Vrchy and in the south Tokaj is bounded by the confluence of the rivers Tisa and Bodrog in Hungary [Regulation EU 1308/2013].

13.1.1. The history of wine production in Tokaj

The Tokaj area is one of the oldest legislative wine delineations in the world, as it was clearly defined and settled in 1737 by the royal decree of Charles III, and the Tokaj wine could only be grown and finished in the 21 sites listed in the decree. During Austria-Hungarian hegemony, respectively, Hungary was the Definitive of Tokaj. After the First World War and the establishment of Czechoslovakia and 'Trianon', the state border divided this region into the Hungarian and Slovak part. Since then, the influence of two states and hence two legislatures have been manifested in the Tokaj region. Slovakia received a smaller part, representing only 10% of the total area of Tokaj vineyards. According to the Act on viticulture and winery 313/2009 [2009] the Tokaj wine-growing area represents in Slovakia a closed wine-growing area bordered by cadastral territories of Tokaj villages Bara, Čerhov, Černochov, Malá Tŕňa, Slovenské Nové Mesto, Veľká Tŕňa a Viničky. The information says that it has an area of 907 ha. The oldest wine-growing village is Malá Tŕňa, which belongs to the original Tokaj villages defined in the decree in 1737. Wine from this village got on the tables mainly of Polish nobility. Polish buyers worked in pairs. One tasted and the other handled money. If the wine suited 'color, odor, and sapor', they bought it. It is no coincidence that one of the wines is called self-made. The name itself is not of Hungarian origin, but of Polish origin.

The Romans probably brought the vine to the territory of Tokaj and the Slavs already knew it too. When the Hungarian tribes came to this territory in the 9th century, they already found the planted vine. Vineyard cultivation became more widespread after Christianity was adopted and even more after the Tatar invasion. As we know from history, few people remained after the Tatar ravages. King Bela IV invited settlers from Italy to the area. The village Bara, in the Slovak part of

Tokaj, bears the name of an Italian town with the same name. New settlers brought new vine varieties. The variety Furmint, which became the basic Tokaj variety, was also among them. King Bela IV. called this land the Italian country. Wine production has grown in importance. Varieties such as Gohér, Balafant, Lipovina, Nutmeg, and Polyhoz were also grown there. In addition to the Italian colonists, the region was occupied by French and German settlers. Wine from this area has long been considered a medium quality wine. So how was the wine of such a quality born?

Photo: S. Marcinčák

Fig. 13.1. Slovak part of Tokaj region, Veľká Trňa, Slovakia

The Protestant pastor Máté Lackó Szepsi postponed grape harvesting because of the war. Autumn in 1630 was favorable for the development of mold and the wine prepared from such grapes was the first aszú. In 1655 the collection of raisins was legalized. It mandated the compulsory removal of noble-rotten grape berries from grape bunches. In this way, the foundation stone of the Tokaj special sweet wine production was laid. The technology and legislation of wine have been unified and the glory of Tokaj wines spread to the world. During the looting of the Tatars, Turks, and royal troops, the wine was sought. Tokaj´s winemakers were digging masked cellars to save their property. They hid people, property, and wine. All this has proved to be advantageous for the ripening of wine.

13.1.2. Climatic conditions

The natural protection of the Carpathian Mountains is the special feature of the Tokaj wine region. It is open from the west by climatic air currents from the great Hungarian lowland. Autumn is mild and sunny. The grapes can mature well. The soil was formed on volcanic rocks [Regecová et al. 2019]. The soils of this volcanic region are varied, but the predominate types are the clay, mixed with various minerals and rocks (rhyolite, tuffa and zeolite) and yellow loess (an accumulation of windblown sand). These rocks contain many minerals, especially potassium necessary in an increased amount for the vine in vegetation [Kraus and Laštovcová 2011]. Vineyards are planted at an altitude of 105–320 meters above sea level. Only south, southeast, and southwest oriented slopes are included in the Tokaj wine region. This type of slope orientation causes the vine shrubs to be exposed to the sun during warm autumn all the day and sufficient amounts of natural sugar and aromatic substances in grape berries can be produced [Furdikova et al. 2015].

13.2. Grape varieties in Slovak Tokaj region

It is allowed to grow and produce wine from only three traditional Tokaj varieties: Furmint, Lipovina and Muscat Lunel (Muškát žltý) in the Slovak part of Tokaj. No more than 10% of the admixture of other varieties particularly of Riesling was tolerated. However, planting other than three Tokaj varieties is prohibited today. In addition to the three traditional varieties, three new varieties, Zeta, Kövérszölö (Fat grape) and Kabar, have only recently been approved in Hungary. These are varieties that ripen rather than furmint and can form noble-rotten raisins (cibebas) more. The Hungarians were able to classify them among the Tokaj varieties even though they were not declared as such in earlier laws.

13.2.1. Furmint

The origin of the Furmint is not known exactly. According to some sources, it penetrated Hungary in 1241 from Italy. Other authors consider that the Furmint comes from the Romanian region Tirnava [Pavloušek 2008]. The most likely account seems to be that it originated from seeds and was later multiplied in the Tokaihegyalja area, from where it also penetrated other areas of Hungary. It is widespread in several European countries, especially in Hungary and Slovakia. In the Tokaj wine region forming the basis of Tokaj wines occupies up to 65% of the area Tokaj vineyards. In our country, it is exclusively used in Eastern Slovakia, especially in the Tokaj wine region. Thanks to its exceptional characteristics, the variety has become the basis for the production of Tokaj wines. Wines are characterized by higher acidity, which guarantees a long wine life. Modern reductive wines of fresh, fruity aroma, full of persistent taste with higher extract content and fresh acids are increasingly produced from the traditional Tokaj grape variety. Fresh apples, as well as citrus fruits, are found in its aroma.

13.2.2. Lipovina

It is probably a Hungarian variety, which originated randomly from seeds. It is widespread mainly in the countries of Eastern Europe, especially in Hungary, where it is grown in all wine-growing areas, especially in the Tokaj region. It is also known in Croatia, Romania, and Krym [Pavloušek 2008]. Slovakia is the only area of the Tokaj wine-growing region, which represents approximately 29% of plantings. Lipovina comprises about 25% of Tokaj wine. The variety has been registered since 1952.

13.2.3. Muscat Lunel – 'Muškat žltý'

Varietas of Muscates (e.g. muscat blanc, violet, red and black muscat) are a group whose origins date back to ancient antiquity and belong to the oldest vine varieties. Their old homeland is Syria, Egypt, or Arabia [Pavloušek 2008]. Thanks to the Romans, Muscat was spread throughout their empire. After the reconstruction of the vineyards, economic reasons pushed Muscates into the background, but to this day they remained represented throughout Western Europe, the Balkans, Turkey, Greece, and the former Soviet republics, especially in the Krym. They are also grown in South Africa and North and South America. It grows mainly in the Tokaj region and represents 5–10% of the total planting of vineyards in the Tokaj wine region. 'Muškát žltý' – Muscat Lunel (Muscat Blanc) can be produced in a reductive way as a variety of wine. The wine is strong, aromatic, with a strong muscat aroma and fresh acid, which is missing in other muscat varieties. Especially naturally sweet wines made from overripe grapes and cibebas are excellent and delicious. Most of the variety, however, is used together with Furmint and Lipovina to produce special Tokaj oxidative wines.

13.2.4. 'Cibeba' – noble-rotten raisins

Appropriate soil and climatic conditions are the basis for Tokaj wines quality. The basis for the production of special Tokaj wines is the production of 'cibebas' – noble-rotten raisins – grape berries infected by noble rot. In good years mold Botrytis cinerea grows into a noble form [Eftimová et al. 2018]. Its hyphae outgrow and grapes, water evaporates, and the content of berry is concentrated. The whole berry shrinks, the sugar content increases significantly, the acid content is maintained and 'cibeba' is developed. In their juice, the fine aromatic substance that gives its special quality to the Tokaj wines is formed.

For the creation of cibebas it is necessary to have suitable climatic conditions in a given year: favorable autumn, when the morning fog and then sunny days. At night, mold works, cracks on the skin, and water evaporate during the day, creating high-quality cibebas. In the middle of September, when the Furmint and Lipovina varieties reach a certain degree of sugar content, under the influence of a small amount of precipitation, scarcely visible cracks form on the berries, through which the noble fungus Botrytis cinerea penetrates the berries and cause their drying. In dry and warm weather, the process begins in the berries in which various chemical and biological phenomena occur, water evaporates from the berries, the natural sugar content is concentrated, some acids break down at the end of the process, which lasts for 10 to 14 days and raisins – cibebas – ripen. The uniqueness of the raisins is also in the grape varieties used – furmit and lipovina, which contain higher amounts of acids, which are also preserved in raisins [Furdíková et al. 2019b]. Together with the sugar present, it gives the raisins an exceptional taste. The surface of the cibebas is ashen, they are chocolate-colored, they are covered with the fungus Botrytis cinerea, shrunken. They have excellent taste, aroma, and high sugar content [Magyar and Sóos 2016]. Their origin and existence are key to the quality of all Tokaj wine specialties. Cibebas, compared to healthy (uninfected) grape berry, differs in visual appearance as well as in chemical composition. Noble botrytization causes a relevant increase of sugars in berry accompanied by an increase of glycerol, ethanol, citric, gluconic, and succinic acid concentration [Furdíková et al. 2020].

The collection of cibebas is very labor-intensive. The best gatherer collects a maximum of 7–8 kg per day. For 3 days it is less than one 'putňa' (the basic Tokaj rate in the Tokaj selection wines production, about 25 kg). Moreover, cibebas are not produced every year and not of the same quality. The creation of cibebas is only in good years with long autumn with cold blows and fogs and warm sunny days.

13.3. Special Tokaj wines

It is possible to produce varietal wines (Lipovina, Furmint, and Muscat Lunel) as well as cuvée or special Tokaj wines, mainly natural sweet wines produced from a mixture of three Tokaj grape varieties: Furmint, Lipovina and Muscat Lunel in the Slovak part of Tokaj. Special Tokaj wines include: 'Tokajské samorodné' (dry or sweet), 'Tokajský výber' (Tokaj selection), 'Tokajská Esencia' (Tokaj essence), 'Tokajská výberová Esencia' (Tokaj selection essence), 'Tokajský mašláš' and 'Tokajský forditáš'. Varietal wines, containing at least 85% of the wine of one variety, are produced both dry as well as containing residual sugars. Wines are matured in wood barrels and produced in an oxidative form, but at present, reductive varietal wines (not matured in wood barrels) are becoming increasingly popular.

Special wines from Tokaj include the categories 'film wines' and 'sweet wines with residual sugar derived from grapes'. Special Tokaj wines are typically oxidative, maturing in 136 l wood barrels with oxygen access under a layer of skin-forming yeast called flor in Tokaj tuff cellars [Furdíková 2019a].

The grapes for the Tokaj wine must be healthy, undamaged, exclusively from recognized Tokaj varieties, and grown only on qualified Tokaj terrain. The technological process of Tokaj wine production is based on differentiated harvesting. Above all, it is a late harvest. The grapes are harvested in late October and November. In particular, grape berries infected with Botrytis cinerea Persoon are harvested, which, through its metabolism, significantly interferes with the physiology of the berries, increases the sugar content, changes the chemical composition and creates a sensory expression of the berries [Furdíková et al. 2020]. These noble-rotten grape berries, called 'cibebas', are concentrated in vats. 'Cibebas' in the higher or smaller volume is an important part of Tokaj's special wines. A juice that flows under its weight is essential [Machyňáková et al. 2019].

13.3.1. 'Tokajské samorodné'

The Tokaj self-made wine (tokajské samorodné) was named after the Slovak term 'szamorodné', which at the end of the 18th century was taken over by the Polish who were buying this type of wine at that time. These wines are produced by a mixture of three Tokaj varieties with or without a low content of cibebas. 'Tokajské samorodné' wine is produced in years when there are not favorable conditions for creating a sufficient quantity of cibebas. The grapes are eaten all together, cibebas are not selected separately.

'Tokajské samorodné suché' Tokaj self-made dry wine contains a maximum of 10 g of sugar per liter and at least 12% of alcohol. In unfavorable vintages with a low crop of raisins – cibebas, only dry Tokajské samorodné is produced. Grapes with a concentration of sugars more than 210 $g \cdot L^{-1}$ containing the minimum of raisins are oxidatively macerated up to 24 h and after pressing, grapes must undergo the fermentation process.

'Tokajské samorodné sladké' Tokaj a self-made sweet wine is produced without a specific added noble rotten berry – cibebas selection, they are processed with the totality of grapes, while the content of sugar should be 240 $g \cdot L^{-1}$ at least. The grapes are macerated up to 24 hours, aromatic and color substances are extracted and must be oxidated partially. After fermentation, the wine matures oxidatively in 136 L Gönc barrels for 1–2 years. The color of the wine is pale yellow to golden yellow with a brownish shade. The aroma of the wine is Tokaj character – overripe fruits, nuts. The taste is typical 'Tokaj bread', honey to caramel tones, and overripe fruit flavor.

13.3.2. 'Tokajský výber'

Tokajský výber – Tokaj selection is made only in good years when a sufficient amount of cibebas is created. According to the old tradition, cibebas were put in special thin bags and stepped on with bare feet. Today it is a special grinder that grinds onions without breaking the seeds. The crumbled matter is slippery and only the seeds remain in the palm when pressed. The rinds have almost disappeared during ripening. The old measure for the volume of cibebas is a 'putna'. One 'putna' is about 25 kg of cibebas covered with 136 liters of one-year Tokaj wine and represents a 1-putna aszú. 'Tokajský výber' is made only as 3–6 'putna' which means 3, 4, 5, or 6 'putna' of cibebas and 136 liters of wine. After mixing, the cibebas are fermented for 18 to 36 hours, decanted and pressed. This liquor is poured into barrels and fermented for various periods, even half a year. It matures for at least 3 years in wooden barrels under a layer of skin-forming yeast. The usual maturation period of Tokaj selection wines is 5–10 years. The wine is yellow to deep amber in color, with a distinctive Tokaj aroma, honey tones, nuts, overripe fruit flavour. The taste is typical Tokaj bread, honey to caramel tones, and an aspect of overripe fruits. These are natural sweet wines, where the sugar content in the wine ranges from at least 60 g $\cdot$ L^{-1} (3 putna Tokaj selection) to at least 150 g $\cdot$ L^{-1} (6 putna Tokaj selection). They have typical amber-like color, sweet honey-like taste, and very full botrytis aroma [Furdikova et al. 2020].

13.3.3. 'Tokajská essencia' and 'Tokajská výberová essencia'

'Tokajská Esencia' – Tokaj essence is compared to the nectar that the gods drank at the Greek Olympus. It has a lot of sugar and extract. It is obtained from ground noble-rotten berries (cibebas), from which it slowly (even over several weeks) flows out of its weight without pressing a gold-brown liquid containing 40–60% sugar. This essence is produced only in years rich in cibebas. For years even decades, it is stored in tiny oak barrels stored in tufa cellars and during this time it may spontaneously ferment slowly. 'Essence' is a diamond among wines, and usually contains 2–3% of alcohol and 450–900 g of sugar per liter. It is characterized by a powerful aroma of honeycombs, dried fruit, and other divine fragrances.

'Tokajská výberová Esencia' – Tokaj selection essence is obtained by the alcoholic fermentation of cibebas from qualified hunts. When harvested, grapes are selected which, after processing, are covered by a must from a defined vineyard or a Tokaj wine of the same year. The choice essence comprises at least 180 g $\cdot$ L^{-1} natural sugar and 45 g $\cdot$ L^{-1} sugar-free extract. The selection essence may be marketed after three years of aging, of which at least two years are in a wooden barrel.

'Tokajský fordítáš' is a wine for the preparation which will be used in the production of a Tokaj selection. Cibebas after preparing Tokaj selection contain lots of sugars and extracts, so they are poured by must or young wine of the same vintage, macerated and allowed to ferment.

Yeast sludge will be used in 'Tokaj mašlaš' after fermentation of Tokaj selections. After fermentation of the Tokaj selections, a considerable amount of sugar and extract remains in the yeast sludge. The fermented Tokaj wine is poured onto the sludge, mixed and left to stand for 4–6 weeks. We get wine enriched with aromatic features, bouquet, and extract substances. The wine matures at least two years, of which not less than one year must require it to be kept in a tufa cellar. The color of 'forditáš' and 'mašláš' is yellow to amber yellow. The aroma is distinctive, Tokaj character – mead, noticeable fruits.

13.3.4. Ripening of Tokaj wines

A typical and important process in the production of Tokaj oxidative wines is the aging of wine in small wooden barrels in typical Tokaj cellars. Cellars often have a common entrance and there are about 20 cellars in the same corridor. The corridors were narrow, excavated in tuff rocks. Tuff is a volcanic eruption into which basement corridors are relatively easy to dig. Various molds have settled on the walls of these cellars, in particular *Cladosporium cellarae*. A microclimate which contributed to the desired course of wine maturation was created here. Using molds on the surface of the walls in the cellars maintains a constant temperature and humidity, which gives the Tokaj wine its taste. Because the corridors were small, only small barrels with a volume of 136 liters could fit in them. Wine is not poured into barrels and a thin biological film is formed on the wine surface.

Compared to the biological layer of Jerez flor-wines, the film of yeast in Tokaj wines differs in appearance and, of course, in yeast species representation. Tokaj yeast film is characterized by a lack of *Saccharomyces chevalieri*, *Saccharomyces cheresiensis*, and *Zygosaccharomyces rouxii* [Alexandre 2013]. On the contrary, it is formed by pseudomyceliar cells of Candida stellata and Candida zemplinina [Magyar and Bene 2006].

After the alcoholic fermentation, young wine is transferred into traditional oak barrels with a volume of 136 L, where the process of maturation proceeds. During oxidative aging in barrels, a thin biological film is formed on the wine surface. The 'Tokajské samorodné', 'Tokajský mašláš' and 'Tokajský Forditáš' must be aged in the barrel for at least one year. 'Tokajský výber', 'Tokajská essencia' and 'Tokajská výberová essencia' must be aged in the cellar in oak barrels for at least two years, but usually it is 5–10 years. The large surface of oak barrels, in terms of volume and the fact that they were not poured to the top, allowed the oxidative course of ripening and thereby created a unique taste of wine called 'chlebovinka' (bread-like).

13.4. Conclusions

'Vinum Regum, rex vinorum' – with this attribute, which is now proudly displayed on almost every bottle of Tokaj wine, the Tokaj wine was offered by the French King Louis XV. However, he was not the first discoverer of the unique taste and aroma of Tokaj wine. Already his grandfather Louis XIV. demanded that the Tokaj wines should never be missing on his table. Tokaj wine was also loved by the German poet Johann Wolfgang Goethe, French philosopher and writer Francois Voltaire, Austrian composer Franz Schubert, Hungarian composer and piano virtuoso Ferenz Liszt, as well as one of the greatest music giants Ludwig van Beethoven. The writer Sándor Márai, a prominent native of Košice, who developed into a cosmopolitan intellectual of European format, was not behind them either. These greats also confirm the importance of this wine with their love of Tokaj wine. Therefore, it is necessary to preserve and develop this gem that we have in Slovakia.

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III

Heritage of plant and animal production

14

Semi-natural grasslands as a biocultural heritage

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Abstract. Grasslands and pastures are plant communities composed mainly of perennials (grasses, sedges, dicotyledonous plants), without species with woody shoots (trees, bushes). Forests constitute a natural vegetation cover in a moderate climate zone, and non-forest communities occur rarely (high mountains, wetlands). Seminatural grasslands are the communities the origin and existence of which are only possible due to human activities. Their species composition depends on environmental factors and agricultural use. The environmental factors include climatic and soil-related parameters. The very existence of the grasslands relies on preventing the development of woody species and removing biomass at regular intervals to promote the growth of heliophilous species. The effects of grazing depend on the grazing method and the animal species and livestock density. Mowing and biomass removal promotes the growth of tall species. Contrary to grazing, mowing is not species selective. Species composition diversity is due to differences in fertilization and mowing time and frequency. Long term and consistent use of these areas resulted in the creation of multi-species grassland communities. A combination of similar habitat conditions and utilization method yields communities of similar species composition. Socio-economic changes reduce the profitability of the traditional, extensive use of grasslands that is necessary to preserve the most valuable natural grasslands and pastures. These so-called semi-natural communities are an important element of the European cultural and historical landscape and serve as the venues of local traditions and customs.

Keywords: semi-natural grassland • cultural landscape • extensive management

14.1. Introduction

The present flora and landscape of Central Europe have been shaped by long term and variable human impact. Different types of forest communities are a natural vegetative cover in most of the European countries [Ellenberg and Leuschner 2010]. However, deforestation created open areas for human settlements and food production based on agriculture and animal grazing. The process occurred in various parts of Europe at different times. The intensity of human impact at grasslands and pastures is considerably lower than at arable lands, and a combination of habitat conditions and different ways of utilization yields a huge variety of diverse grassland ecosystems [Hejcman et al. 2013]. In the broadest sense defined by the Oxford Dictionary of Plant Sciences *Grassland occurs where there is sufficient moisture for grass growth, but where environmental conditions, both climatic and anthropogenic, prevent tree growth. Its occurrence, therefore, correlates with a rainfall intensity between that of desert and forest and is extended by grazing and/or fire to form a plagioclimax in many areas that were previously forested* [Allaby 1998]. By these definitions, grasslands cover some 40 percent of the Earth's surface (excluding Greenland and Antarctica) [White et al. 2000], showing huge diversity of habitat conditions and methods of utilization [Allen et al. 2011]. In Europe, both grassland area and diversity are much smaller [Peeters et al. 2014], mainly including improved, semi-natural and natural grasslands. Natural grasslands, the occurrence of which is unrelated to human impact, are valuable in environmental terms but due to their limited area, they do not play a significant role. Improved grasslands cover soils of high or moderate quality, are intensively used, fertilized, and provide high yields. They also feature simplified species composition. The most valuable type of grasslands are the semi-natural ones, as they allow for preserving botanical diversity, landscape, and cultural values and they fulfill other ecosystem roles [Sollenberger et al. 2019]. They are permanent, low-yielding green areas dominated by native grass species, other herbaceous plants, and sometimes even shrubs or trees. Apart from mowing or grazing these plant communities have not been considerably modified by fertilization, liming, melioration, plant protection products, or sub-sowing breeding cultivars of grass and legume species [Peeters et al. 2014], and have been for years used according to local traditions. The semi-natural grasslands are among the plant communities with the largest number of species in the world [Wilson et al. 2012], and are the central element of the High Nature Value Farming concept [Andersen et al. 2003].

14.2. History of grasslands in Europe

Grassland species have existed in Europe at natural, non-forest areas of variable sizes for 1.8 million years, and probably even longer [Pärtel et al. 2005]. From there they could easily be transferred to permanent grasslands established for animal grazing. Herding was introduced in several stages around 5000 BC in Central Europe, about 1000 years later in Western Europe, and about 2000–3000 years later in the Baltic region and Scandinavia [Champion et al. 2009]. In the beginning, it took place in the forest, which was also from where winter forage was obtained in the form of deciduous tree twigs and branches [Pott 1988]. Mowed grasslands were established later, around 600 BC [Pott 1988]. The first scythes date back from 6th to 7th century BC, and information on the cultivation of grasslands can be found in the works of Roman authors. Also, palynological evidence confirmed the existence of multi-species grasslands in Central Europe in the Middle Ages [Hejcman et al. 2013]. Intensively used and fertilized grasslands arose in Western Europe at the end of the 19th century [Pott 1988].

Grasslands in the Carpathians are associated with Wallachian nomadic tribes wandering along the mountain ridges in the 13th and 14th centuries. In the beginning, herding used to be a nomadic activity, and then, from the end of the 14th century, it developed into transhumance. In the summer, animals grazed at natural or man-made montane grasslands near the mountain peaks or even in the forests. In the winter, they were moved back into the valleys and farm pens. Winter forage obtained from forest clearings at lower altitudes was supplemented with tree branches [Kowalska-Lewicka 1980]. A typical feature of transhumance is herding sheep from different owners by one shepherd. Currently, this herding method is still followed in the Carpathians, mainly in Romania [Huband et al. 2010], in Ukraine [Warchalska-Troll and Troll 2014], as well as in other European mountains, e.g. in Switzerland, Scandinavia, France and Spain [Liechti and Biber 2016].

14.3. Habitat factors shaping the species composition of grassland communities

In the past, grasslands were mostly created at locations where conventional tillage was impossible due to excessive humidity, low fertility, or slope inclination. Therefore, the most valuable grasslands with the largest number of species are found on the so-called marginal habitats [Hopkins and Holz 2006].

The most important natural factors with synergistic effects include soil factors (fertility, humidity, and soil pH), and climatic factors (precipitation, temperature, duration of a growing season). Natural soil fertility depends primarily on the type of parental rock and maybe improved via fertilization. The high content of nutrients allows for achieving high yield, as plant species capable of taking advantage of the favorable conditions grow fast and reach a considerable size. Most other species, particularly small and heliophilous ones cannot withstand the competition. As a result, such communities feature low species richness and are usually dominated by tall grasses [Hejcman et al. 2014]. Habitats with the soil of very low fertility (currently are rarely used) also harbor a small number of survivable species. As per a theory describing the relationship between species diversity and productivity [Grime 1973], at first, the number of species in plant communities grows together with growing productivity until it peaks at intermediate biomass level, and then it decreases with growing biomass production.

Water availability is another crucial factor in shaping the species composition of grassland communities. Grasslands can be found along the entire humidity gradient, from wetlands or near-water to extremely dry habitats [Dengler et al. 2014]. In Central Europe, most grasslands used to be found in areas with relatively high soil moisture including e.g. regularly flooded riverside cars, swamp habitats with stagnant water, and mountain areas with low temperatures and high precipitation. Water supply affects also other factors such as the rate of organic matter mineralization or nutrient availability.

Soil pH is a very important soil parameter that determines plant growth both directly and indirectly by modifying nutrient uptake. Communities on soils with high pH usually feature higher species richness, as such habitats used to be more abundant during the evolution of the grassland flora [Pärtel 2002].

The climatic factors change depending on geographical location. The factors most important for grassland species include precipitation and temperature. In mountain areas variability of these climatic factors depends on altitude [Austrheim 2002], as increasing altitude is accompanied by decreasing mean temperature and shortening of the growing season. Moreover, mean precipitation tends to increase but with considerable local differences due to surface relief.

Apart from habitat factors, species composition of grassland communities depends also on local availability of plant diaspores, such as seeds or vegetative organs taking part in reproduction, e.g. roots, shoots, or bulbs. Colonization may also depend on the presence of close enough diaspore sources (i.e. other grasslands). The diaspores spread with the wind [Poschlod et al. 2003] or with animals that carry them inside (endozoochory) or outside (exozoochory) their bodies [Couvreur et al. 2005]. The grassland size and connections between grassland habitats also affect plant spread [Soons et al. 2005], both currently and in the past [Cousins et al. 2015].

14.4. The effects of land use on species composition of grassland communities

Apart from the habitat conditions and the pool of available species, grassland species composition depends also on human activities that in various ways limit the growth of some species and promote the growth of the others. Continuous low-intensity impact such as mowing or grazing is a decisive factor affecting the growth of large, dominant species and limiting the possibility of competitive exclusion of other species [Bakker 1999]. Land use introduces disturbances and creates micro-habitats, which according to the intermediate disturbance hypothesis [Conell 1978], increases the possibility of co-existence of many species. This explains the key role of extensive land use in maintaining a significant number of multi-species plant communities [Halada et al. 2011].

Grassland cultivation facilitates the occurrence of some species and limits the presence of the others. The basic methods of grassland use include grazing and mowing [Bakker 1999]. Animals affect species richness in their pastures via plant removal and trampling. Plant removal allows light to reach the lowest vegetation layers and soil surface. Animals feed on some species more willingly than on the others, and there are also species they do not eat at all. Selective defoliation changes the competitive edge between species not only by direct removal of plant biomass but also by changing light conditions and competition over soil nutrients [Rook and Tallowin 2003]. Trampling creates spots devoid of vegetation resulting from the mechanical destruction of plants. These spots are places where many plant species can germinate, and they also facilitate the spread of creeping and runner-producing species. Grazing enables the occurrence of annual species and favors small, creeping, and stoloniferous plants over tall, erect, and clump-forming ones [Díaz et al. 2007]. As a result, species composition on pastures depends on stock density [Díaz and Cabido 2001], grazing frequency and duration, and animal species [Rook et al. 2004].

Mowing also reduces asymmetric competition from large and fast-growing plants. However, unlike grazing, it is not selective. Mowing promotes dispersion of a large number of species, which is why mowed grassland communities usually (but not always) boast greater floristic richness than pastures. The effects of mowing grassland communities depend on the frequency of mowing and its time, and particularly the date of the first harvest [Smith et al. 1996]. Mowing too early (in relation to plant phenological development) may prevent seed formation in species that reproduce only in a generative way, while mowing too late may result in the development of a dense vegetation cover that would inhibit the growth of new plants. Frequent mowing favors species with leaves located close to the ground and limits the tall ones. Moreover, tedding, drying, and transporting hay may facilitate seed dispersion both within the same grassland and between remote grassland areas.

In some cases, fertilization can quickly and drastically change the species composition of grasslands. The main purpose of fertilization is to achieve high yield. Grasslands are fertilized either with organic fertilizers in the form of manure or slurry or mineral (artificial) fertilizers. While at the same dose of active ingredients the effects are similar, the organic fertilizers act more slowly and increase the organic matter content in soil [Kirkham et al. 2008]. Nitrogen fertilization seems to produce the most pronounced effects. It favors nitrophilous species, especially grasses that are characterized by rapid growth and high productivity, and competitively excludes less nitrophilous species. Phosphorus fertilization brings about similar results. It has been recently considered an equally important factor that together with nitrogen enhances the productivity of ecosystems. Increased supply of these elements decreases species diversity and richness on permanent grasslands. Phosphorus and nitrogen fertilization enhance the share of legume plants capable of assimilating atmospheric nitrogen. Negative effects of phosphorus on species richness are visible mainly in areas where high doses of fertilizers have been used for many years [Diekmann et al. 2019]. In the Carpathians, where the soils are poor in phosphorus and agriculture intensity is low [Smoroń et al. 2010], the threat to species richness due to phosphorus fertilization of grassland communities is small. Depending on the treatment, the same place can harbor plant communities of different floristic composition. Trends in species composition changes due to different land use or abandonment have been discussed by numerous authors [Kozak 2003, Peter et al. 2008, Wesche et al. 2012].

14.5. Effects of natural factors and human activities on the shape of grassland communities

Similar environmental conditions and similar land use give rise to the development of plant communities featuring similar floristic composition and plant species present only in these communities (characteristic species). The description and classification of such systems are the subjects of phytosociology [Mucina 2006]. The principles of phytosociology are used in scientific research, environmental management, biomonitoring, and nature conservation. The most important phytosociological units of grassland communities in the Polish Carpathians include [Matuszkiewicz 2006]:

Class: Molino-Arrhenatheretea – Anthropogenic managed pastures, meadows and tall-herb meadow fringes on fertile deep soils at low and mid-altitudes.

Order: Arrhenatheretalia elatioris – Mown meadows and pastures on well-drained mineral soils.

Arrhenatheretum elatioris meadows are located at optimal altitudes for agriculture, usually below 600 m a.s.l. They are usually found in valleys, near farms, on relatively fertile soils, and provide a rather high yield. They are typically fertilized and mown twice a year. Dominant species of tall grasses include orchard grass, false oat-grass, timothy grass, or meadow fescue. Legume species usually include red and white clover. The share of large dicotyledonous species such as rough hawksbeard, broad-leaved chervil, meadow salsify is high. Species richness varies and depends mainly on fertilization level.

Bent-grass meadows – commonly occurring at subalpine altitudes from about 600 m a.s.l. up to about 1300 m a.s.l. They feature lower biomass production but greater species richness than ryegrass meadows. These meadows are usually moderately fertilized with manure, cut once a year but grazed in the fall. They often harbor many rare and protected species. Dominant low grasses include common bent and red fescue. There are also many dicotyledonous species, e.g. brown knapweed, lady's mantles, bellflowers, and many other small species. The most important community is Gladiolo-Agrostietum meadow with *Gladiolus imbricatus* and commonly occurring species of the orchid family. These communities belong to those with the greatest species richness in Poland.

Pastures are usually characterized by low growing plants and limited species richness. A dominant species is crested dog's-tail, accompanied at lower altitudes by perennial rye grass (Lolio-Cynosuretum association), and at higher altitudes by red fescue (Festuco-Cynosuretum association). Other typical pasture species are white clover, caraway, common daisy, and autumn hawkbit.

Order: Molinietalia – Wet mown meadows on mineral and peaty soils.

The most popular meadow association in wetland habitats is Cirsietum rivularis meadow. Its dominant species (*Cirsium rivulare*) gives the entire meadow a purple color during flowering. Less common species include tufted hair grass, smooth black sedge, and lady's mantles. Low fodder value makes these communities less and less used.

Class: Nardo-Callunetea – Secondary mat-grass swards on nutrient-poor soils at low and mid-altitudes.

Nardetalia communities emerged on acid and poorly fertile soil and were used as pastures. In the past, these communities dominated the grazing areas. Apart from the dominant mat-grass, the meadows also harbor pill sedge, heath grass, and erect cinquefoil.

Class: Artemisietea vulgaris – Nitrophilous tall-herb vegetation on the banks of water reservoirs and in ruderal habitats.

Rumicetum alpini community is not shaped by mowing or grazing but is indirectly related to shepherding. It develops at the sites heavily overfertilized by animals, usually near the shepherds' huts. The community is practically a single species one, as lush foliage and well developed underground organs of Alpine dock dampen the development of the other species. It continues to grow at these sites long after the grazing ceases.

14.6. Threats to the existence of semi-natural grassland communities

The species composition of semi-natural grassland communities depends on human land use and is subject to constant changes triggered by socio-economic transformation and development of agricultural technology. The pace and advancement of these changes vary across Europe but there are some common trends [Wesche et al. 2012, Dengler et al. 2014, Diekman et al. 2019]. Enhanced agricultural productivity and easily available sources of non-agricultural income make the traditional, extensive use of grassland unprofitable. The grasslands with favorable environmental conditions (good soils, small inclination, low altitude) and land structure (large farms with non-scattered fields) are used more intensively. Farming aims at a high yield of good quality forage, and the basic method of achieving this is increasing fertilization, particularly with nitrogen. Both mineral and organic fertilizers are used. Animal herds are usually large, which makes grazing cease in favor of indoor farming based mainly on concentrate feeds obtained outside of the farm. Indoor farming generates a large amount of manure that in a form of slurry is used to fertilize grasslands. The slurry is an organic fertilizer, but unlike farmyard manure, it does not contain nutrients in the right proportions and is usually used at large doses. Its components can be utilized by only a small number of species, which results in considerable restriction of species richness. Modern, highly productive animals, especially cattle, require easily digestible feed with high nutrient content. This requires early harvest, like fiber content increases along with plant development, especially in grasses, and this worsens the feed digestibility. The need to produce highly valuable feed forces also a shift from drying to silaging the green matter. However, the biomass from the early harvest used for silages must have a proper chemical composition. Early harvest and resulting in a greater number of cuts eliminate many species that are not resistant to reaping. Also, harvesting before seed maturation prevents the spreading of plants, and the grassland cover includes mainly permanent species and those that favor vegetative reproduction. In many cases, plant cover of such grasslands is limited to only a few species [Plantureux et al. 2005]. Intensification of grassland use has been observed for many years, mainly in Western Europe [Hodgson et al. 2005].

In areas where external conditions make the production intensification impossible, e.g. in the mountains, grassland use is often abandoned. This usually happens gradually, starting from hilltops and forest clearings far from the farms, and located on steep slopes and less fertile soils. In the past, these areas were mostly used as pastures and meadows, and they have developed communities boasting the greatest species richness and harboring many rare species. Some of these areas have been afforested, others undergo secondary succession, the last stage of which is the restoration of a forest ecosystem. When the biomass is not removed, it creates a layer of non-decomposed matter that prevents germination and growth of many small species and promotes strongly growing and clonally reproducing species. Soon shrubs and trees enter the area initiating strong competition, mainly for light, with herbaceous plants. All those factors make meadow species disappear. The rate of these changes varies depending on the type of plant community, habitat conditions, meadow size, and the neighboring plant communities. Grazing and production of winter fodder occur on formerly arable lands located close to the farms. They are usually more fertile and productive and thus feature a simplified species composition [Zarzycki and Bedla 2017]. The absence of many meadow species is also due to the short life span of such communities, insufficient for the species migration from the places of their occurrence. In many villages, grazing was completely abandoned, and mowing depends on whether it is subsided. The abandonment of the use of marginal areas occurs, albeit to a varying extent, throughout Europe [McDonald et al. 2000].

Grasslands are not only an important element of the European cultural landscape, but their use also gave rise to the creation of many elements of material and non-material culture [Warchalska-Troll and Troll 2014]. They used to be particularly important for local communities in the areas where animal breeding was the main economic activity. This usually happened in the mountains. Cultural differences in the Carpathians between the people of Wallachian origin, inhabiting higher parts of the mountains, and people from lower altitudes, were considerable. Rituals and traditions were mainly associated with herd relocation, grazing, and cheese production at the grasslands.

Numerous grassland communities tended to traditionally, e.g. mat-grass communities or heather-covered pastures, that dominated mountain meadows and clearings in the higher parts of the Polish Carpathians in the middle of the last century, have practically disappeared now [Nowak 1951, Prończuk 1958]. Currently, mat-grass communities are extremely rare. Their area, as compared to about 50 years ago, dwindled by about 50–80% [Korzeniak 2016], and they currently occupy the first place on the list of endangered habitats in Poland [Lista siedlisk...].

14.7. Conclusions

Semi-natural grassland communities have been shaped by a combination of natural conditions and many years of human economic activities. Economic and political conditions (demand for agricultural products, subsidies) forced transformation of grasslands into arable lands (e.g. during wars) and then back into grasslands when the agricultural production was less profitable (e.g. in the countries of the former Eastern Bloc after political change-over at the beginning of the 1990s). The changes also involved the type of land use (grazing, mowing), and its intensity (fertilization level, frequency of mowing, animal density). As a result, the species composition of grassland communities has changed much faster than 'natural' communities (forest). For these reasons, the semi-natural grasslands are an important element of not only the cultural landscape of Europe but also of history and local traditions and customs.

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15

Shepherding and Wallachian dialect – the relicts of the Carpathian Mountains range economy

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Abstract. The regions of the Carpathian Mountains were settled by Wallach, who started their wandering, from Balkans Mountains, towards the north, in Medieval Ages. The chapter concerns the Wallachian tribes' origin, their nomadism and transhumance pasturing. The movements and survival of Wallachian were based on a few, specific for mountain regions animals, which, up today are the indicators of that specific economy existence. The base of transportation and sub mountains valleys farming was the Hutsuls' horse; the Zackel sheep and Carpathian goats with the specific small size, meat-milk utility, Red Cattle. The Wallach assimilated with the Carpathian Mountains native tribes, building the common communities and founding cottages 'on Wallachian law'. The western border of Wallachian wanders was Moravia (in Chechia) so all nations living in the mountains borrowed the language of nomadic shepherds, even the names of the whole, until this day existing families, were of Wallachian origin. In the Polish land, at that time, they bounded themselves to the Polish Gorols (highlanders) and the dialect of Gorols is of Walachian origin. The municipalities found at that time were the beginning spots of Polish shepherding. The traditional Gorols redyk is a reminiscence of the transhumance traditions in different parts of the Carpathian Mountains. The Wallach created the specific rules of everyday living in the shepherds' hut economy based on their construction of shepherds' huts and tools, customs of everyday activities. Also, the craft and culture were combined with transhumance shepherding. Basic activities of that communities focused on pasturing of animals in the uphill meadows and mountains slopes and with the Carpathian, traditional cheese-making art.

Keywords: Carpathian Mountains • Wallachian dialect • Polish shepherding • traditional cheese

15.1. Introduction

Life and farming in the mountain and sub-mountain areas have not been the easiest. Difficult climate conditions (long snowy winters, short vegetation period), weak, rocky soil made agriculture to narrow to grow of basic plants which allowed to men and animal feeding (mainly through pasturing). Thick, large, difficult to walk, present on high mountains' slopes forest areas, and the lack of tracts and routes also did not favor the settlements in the region. In the Middle Ages, the area of the Carpathian Mountains (among them Beskid Sądecki range and the Tatra Mountains) was almost uninhabited. Sheepherding is the oldest and the most important form of a strenuous life of Carpathian Gorols (also in the Podhale region). Where the environmental conditions allowed to live the settlements were placed and their inhabitants were pasturing small herds of sheep and goats (kierdle, kyrdle). The wild brachyceric shorthorn cattle present, at that time in the eastern part of the middle Europe regions, was the only cattle which was pastured near former primitive settlements.

15.2. The Wallach's (Vlachs) tribes' origin

At the end of XIIth and beginning of the XIIIth centuries, the stagnated, poor economy in the mountains changed – the Wallachs shepherds moved in their big wandering from Balcans towards and along the range of the Carpathian Mountains. The oldest written sources containing information about Vlachs originate from the southern Balkans region. In the VIIIth century, the annals in Aegean Macedonia describe the place named Vlahorihini and between years 976 and 980 A.C. the shepherds' tribe – Vlachs living in the territory of contemporary borders of Greece, Macedonia, and Albania [Olszański 2000].

The oldest name for Walachs is known from the VIIth century – a Greek word – Vlah (plural Vlachoi), which was taken over from Greeks to southern Slavian language in not much changed forms: Vlah, Vlachi, Vlasi, Vlachie, Vlech [Czajkowski 2008]. This description is still present in the Balcans area. The colloquial expression in Serbia and Croatia (southern Slavians) the word Vlach was describing all sheep shepherds; in Poland Walach; in Chechia and Slovakia – Vlach, Valach, Valas; in Hungary – Olach, Volach, Oláhok, Olahi; in Serbia-Cincar (from Roman word cinque – five – Wallachs were said to be the descendants of the Fith Rome Legion which was garrisoned in the Balcans); in Albania – Cioban, and in German documents Walk – the ancient inhabitant of the today's border region between Greece, Macedonia, and Albania and the regions of contemporary Romania – at that time the territory of the first and second Bulgarian Empire. The mountain regions there – in Romania – were inhabited by Wlachs – the shepherds' tribes which because of nomadic type of living had more freedom than the other inhabitants' second empire. The second Bulgarian Empire (XII–XIII centuries) was officially named as Bulgarian and Vlachs Empire. The name – Bulgarian was assigned to people who spoke the roman language (Romanian) involved in agriculture with a settled type of living. Vlachs were named people who were Slavians, Nomads, etc. involved in shepherding. The Vlachs lived also in Transylvania so, at that time, anyone can find the name of XIth century country of Pechenegs and Vlachs. In 1222–1224 the region of the Fogaraska Basin, to the west from Sibiu was called 'terra BlachWallach's – the land of Walachs'. The wars with Byzantium and victimization of peasants caused that the nomadic part of society – shepherds started to migrate with the herds of sheep and goats to the north along the Carpathian Mountains range to find a new place for animals grazing and a new location for freedom life. The Ruthenian people named the wandering, through their lands, shepherds Wallach. To Wallach, at that time, it was hard to describe some common characteristics like nationality or society only common for them was religion – they were Christians of the eastern rite (the Orthodox). They were rather the job group involved in mountain pasturing of so called 'small cattle' i.e. sheep, goats, rarely pigs (the pigs are not suitable for mountain wandering) [Pasierbek 2012, Zuskinová 2018]. According to Czamańska [2015], the name Wallach describes a few ethnic groups which existed in the frames of clan tribe structure which never develop their own national entity. The wandering Wallachian shepherds used for pasturing of animals the Carpathian forests, meadows and forest clearings and the nations (Ruthenian, Polish, Slovaks) whose lands the wanders were passing by taken over and assimilated the culture, rites, vocabulary and also the system of shepherds' economy – the summer mountain pasturage or 'huts economy'.

15.3. Wallachian settlements in Poland

At the beginning of the XIIIth century the numerous groups of Wallach settled on the Polish lands mainly in Red Rus, Podole, Lubelskie assimilating the local culture but still keeping shepherding and animal breeding as the main way of life [Czajkowski 2008a]. Polish king Casimirus Great the IIIrd conquered the lands of Halicka Rus in 1340 and granted the settlement privileges to those Wallach's who deserved during the fights. The first settlement privilege 'on the Wallach law' was edited in 1377 in Hodle Pole (the beginning of the location of villages 'on the Wallach law'). The location of the village 'on the Wallach law' differed from locations 'on Germans law' or 'on Polish law' by the renouncement from serfdom gathered as cereal grains and free of payment work in the landowner property, whereas the settlers were obliged to gather the sheep (leather belts, cheeses) or the money (twenthe from sheep named 'strunga' and tithe from pigs breeding named 'żer') serfdom.

15.4. Rules of the "Wallach's law"

Starting from the XI century the Wallach law (ius Valachiccum) guaranteed the possibility of free moving and carrying weapons and imposed the military duty for serving the country. The Wallach cavalry from Moldova – 400 horses fought in 1410 in the Grunwald battle. The founder (zasadźca) of the settlement – the person who organized (located) the village or town – was granted the location act from the seigneur (king or his deputy) was named a prince (kniaź) – the equivalent of a mayor (for locations on 'German law'). Kniaź (knez) had jurisdiction permissions and a privileged economic position with a rather wide ruler's permissions towards the inhabitants of his settlement. The rural community (gromada – group) of the settlement located 'on Wallach law' had a wide range of permissions which were performed through general meetings of all inhabitants of village or land (so-called 'gatherings' – zbory, 'gatherings jurisdiction' – sądy strungowe) [Szandra 2012]. The courts were placed in the maternal village so-called 'watra' ('fireplace', 'hearth'). The trung (lawsuits) took place once a year, usually in July. Also at that time, the King's serfdom was paid. The other name of local rulers in the Polish and Romanian lands was 'chief of the valley' (the head of gathering). The groups of settlements based on Wallach law gathered together were called 'land' (Karina) and were governed by a chief named landlord (Krajnik). The landlord was the head of local rulers – princes. The full authority was assigned to the landlord in the scope of executive and jurisdiction power [Szandra 2012]. Often the name of 'Wajda' – voivode was a substitute for Krajnik's name. The voivode was also performing the border, roads, and control duties to keep the public order. The voivode kept an eye on toll gathering, obeying of the prohibition of leaving the settlement and registered free-living (wandering) people. The above activities were executed to diminish robberies and bandits' assaults. The typical characteristic of Wallach law was 2 step jurisdiction structure. The basic unit was the village lawsuit executed by prince (kniaź) to arbitrate the problems of the village community. The higher organ was so-called corporate lawsuits (sądy strungowe) where the problems concerning the group of villages were arbitrated (sądy krainy) [Szandra 2012].

15.5. Wallach's settlements and villages – the beginnings of Polish shepherding

The first Wallach's settlements, where pasturing was the only job of inhabitants, had not the stable character. The Wallach pastured their herds in the meadows, idled lands, in forests, and were not bound to the one place. They husband the commune manor lands, the single houses spread in the forests, the lowland meadows or the mountain clearings. The situation changed when they came into contact with settled ethnic tribes and the assimilation of Wallach with Ruthenian gave the beginning of Lemko, Bojko, and Hutsuls tribes. The Wallachian shepherds found the new settlements or joined to already existing communities. The wandering groups of Wallachian still followed the western direction of movement (along with the Carpathian Mountains range) pasturing their herds of sheep and goats, leading the half nomadic life. When the grass on pastures where they were staying was finished the wanderers continued their journey to the west. In that way, the groups of wandering Wallachian shepherds reached, in 1373, the region of Dynów near San river (the Carpathian northern sub-mountain area – Pogórze Karpackie) where the settlement named Wołosze is described in annals [Czajkowski 1999]. Czajkowski [1999] reports that in 1395 the group of Wallachian entered the town of Nowy Sącz during the king's meeting of Jagiełło and Jadwiga – Polish royal couple, Prince Witold (ruler of Lithuania) and the Hungarian king Sigismundus of Luxembourg. At the same time the Wallach's settlement in Slovakia was developing from the two directions: by the eastern corridor (Mamaro – Carpathian) and by the southern corridor – from Balcans through the Hungarian Lowlands into the Gemer Mountains. In the XIVth century the oldest villages, at the territory of nowadays Slovakia, were found – Koroma (1337), Jasenove (1348), and Szarzysz – Orlik Niżny (1357). The boom of Wallach settlement took place in the XVth century when the wandering shepherds penetrated forests and mountains in Szarysz and Spis colonizing the former existing villages in the Poprad river valley (Jakubiany) and Górna Topla to the south from Čergov Mountains (i.e. Ruthenian Village near Presov, Šarišske Jastrabie) reaching the region of Valaskej Dubovej (Orava) and Zilin (Kisuce).

In the XVIth century, the next wave of settlement took place when the empties and old settlements were colonized. The example of the above was colonization by

Wallachian shepherds of the mountain area of Higher Orava, which started in 1575 [Czajkowski 1999, Czajkowski 2008a]. As a result, the dynamic shepherds center was found, where, in 1619, at about 24 thousand of sheep were grazed [Czajkowski 2008a]. Osturňa (Ostrunia), placed in Magura (Hillock) Spis slops of hills, is the furthest western village in Slovakia. In 1406 the group of Wallach robbed the town of Stary Sącz [Dobrowolski 1961] and in 1413 the eight people group of wandering shepherds with David Wołoch as chief settled the Ochotnica Village in the Gorce Mountains. At the end of the XVth century, the Wallach reached the Wadowice region [Chomętowski 1876] and Żywiec region, where they developed their typical form of shepherd's economy. In the peak point of this form of economy, in 1914, in the region of Żywiec 50 shepherds-hut communities were functioning [Sawicki 1919]. The heavy winters in the northern areas of the Carpathian sub-mountains were leading to the tragedies. Dobrowolski [1962] reports that at the breakdown of 1490 and 1491 all camping Wallach and their herds were frozen out near the Pilzno region. The Medieval colonization of lands was moving mainly along the Carpathian Mountains range but in XVth and XVIth ages the Wallachs started expansion into lowland territories of Bełsko, Chełm and Lublin regions founding the new settlements or 'wallaching' already existing cottages [Czajkowski 2008b].

In XVIth century the new wave of Wallach settlement and colonization on 'the Wallachian law' of the Polish part of the Carpathian Mountains took place, which gave as result location of the new cottages – 'on Wallachian law' found in the 'Muszyński Key' (clef) in Beskid Sądecki (Szczawnik, Zubrzyk, Krynica, Izby) and to found villages in the Podhale and Beskid Śląski. In Beskid Śląski the first settlement was shepherds hut, in the region of Śląsk Cieszyński, of Mosty Jabłonkowskie (1590) [Popiolek 1939]. The most of shepherds' cottages originated in that region between years 1621–1654, when 30 shepherds-huts were existing and 10.000 of sheep were kept with 800 of cattle [Popiołek 1939]. In the area of Lanckorona county, the XVIth century cottages with shepherd's economy included: Jachówka, Trzebunia and Bieńkówka and the biggest Wallachian village of the whole region – Zawoja, where the families and groups of settlers were colonizing rivers valleys ('colonization of streams') and built the pasturing and farming foundations. In the XVIth century in the Polish part of the Carpathian Mountains were common the free wanders with herds and winter (from November to April) temporary stops in the forests of Sandomierz and Oświęcim Lowlands [Dobrowolski 1938, Dobrowolski 1970]. The groups of wandering shepherds were met in 1605 in the forests of Beskid Żywiecki [Dobrowolski 1962]. At the end of the XVIth century on the slopes of Gold Groń in Beskid Śląski, the Wallachian settlers appeared, who located the village of Istebna. The first inhabitants of so-called Beskidzki Villages Triangle – Istebna, Koniaków, and Jaworzynka came to the place to found it from Górny Śląsk (Upper Silesia). Parallelly the free wandering Wallachian herders appeared, who found farmsteads near the main villages. Most probably these wanderers came from the Slovakia region because there was a village there called Istebné and the name was brought to Polish Upper Silesia. The Wallach started the shepherding in these lands what soon turned out to be more profitable than agriculture. That fact is a kind of symbol of the so-called 'Walachian colonization' in Poland because there started the history of Polish pastures and shepherds who adapted Wallachian traditions and the economic system. The transhumances grazing was present in the Śląsk Cieszyński area even in the XXth century when Gorols from Brenna and Wisła villages were hastening their herds to so-called 'doły' (pits) [Kopczyńska-Jaworska 1950/1951].

15.6. The western border of Wallachian wanders – Moravia

The most recently occupied and the farthest west area of the Carpathian Mountains is Moravian Vlachia (Valašsko), located in the territory of Chechen Moravia and including the hills and slopes and mountains rivers basins of Vesena and Roznowska Becva and the ranges of Vesena Mountains (Vsetinské Vrchy), Sycamore Mountains (Javorniky) and the western part of Silesia-Moravia Beskid (Morawsko-Slezské Beskydy).

The Wallachian colonization there took place from XVIth and in the XVIIth centuries and was mainly based on migration from the close region of Cieszyński Silesia [Kłapyta 2013]. In 1620 the group of at about 50 Wallachian families originating from Cieszyński Silesia found at the bottom of Radhost hill, in the Silesian-Moravia Beskid, the range of shepherds huts giving the start of the proper colonization 'on the Wallachian law' what is confirmed by the names of locations such as Valassko Miedzyrzecze and Valassko Bystrica [Štika 2007]. The surrounding of today's village Cadca – Gorne Kysuce was late inhabited – in the middle of the XVIth century. The first written note of the Tzaczka cottage originates from 1565 and the next, from 1572, classifies Cadca as a regular village. In this region stopped the wave of Wallachian colonization and settlement, which was aiming west along with the Carpathian Mountains range. The movement of Wallachian shepherds is confirmed by the repeating names of settlements such as Międzybrodzie in Orava and the three villages with the same name: Międzybrodzie Kobiernickie, Lipnickie, and Żywieckie; Ponikiew near Wadowice and Ponikiew near Międzybrodzie; Zembrzyce near Sucha and Zubrzyca in Orava; Koziniec in Orava, Koziniec near Wadowice (near Vistula river) and the Great Koziniec in Cieszyński county [Woźniak 2015]. The oldest settlements 'on Wallachian law' in the Polish part of the Carpathian Mountains based on shepherding schemes brought by the Wallachian shepherds from Moldova and Transylvania lands, where the grazing was performed on the large lands of villages or as seasonal summer pastures far away from cottages, which both were bestowals from kings.

15.7. Nomadism and transhumance pasturing

The nomadism and transhumance pasturing i.e. the extensive form of pasturing based on the whole year grazing of herds and seasonal shoot of cattle – in summer in the mountains on the highland meadows (alps-hale, polonina) and winter in valleys and uphill plants, where thanks to the milder climate conditions the herds could be feed (the centrum of management always was the village), were the way of living of Wallach in Balkans, in the early Medieval Ages. Thanks to that activities were used and managed alps and meadows with the parallel sustaining of backups in the lowlands or in the mountain valleys where the fed for animals for winter was gathered. Yet in the XIVth century was known for the division to Wallach villages settled with the agricultural economy, and to wandering shepherd's groups – katuny [Jawor 2004]. The transhumance pasturing was not only herd's 'vertical' movement in the area of the same mountain range but also of seasonal movement, for long distances, between different geographical lands. The Wallachian colonization was based on cutting out of the forest and founding of villages on the so-called 'raw root' or conveyance of the older, already existing municipalities 'on the Wallachian law'. What actions took place the most often in the sub-mountain regions where the poor quality soils and the hard climate conditions lead to the economic weakness of municipalities. But parallel intensified sheep and goats grazing in the area of the primeval Carpathian forests, 'cerhlenie' (grubbing) of trees and burning out of forest influenced on formation of meadows and pastures on slopes of hills [Kohut 2013].

15.8. Assimilation of Wallach with the Carpathian Mountains native tribes

After coming to the Carpathian Mountains the Wallachian people according to their habits pastured herds in the summer in the mountains and during winters came downhills where, from ages, the Ruthenian peasants were living, who were the Orthodox Christians similarly like Wallach. Because of the same religion, Wallach was assimilated very quickly bringing at the same time a few norms and economy forms characteristic for shepherd's life and formed by the Wallach during living in Balkans. So the natural combining of two kinds of economies – agricultural of Ruthenian autochthons with shepherd's abilities of Wallach. The Wallach took up the settled type of life – agriculture, language, and religion and combined with own developed animal breeding and seasonal wanders with herds, the veterinary knowledge, the breeding nomenclature, etc. [Mulet 2012]. Thanks to above there was possible usage and management of areas localized up hills with parallel backups kept on the lowlands, where the fed was gathered for feeding of animals in winter. The climate of the western Carpathian Mountains was far away different than that in Balkans so the Wallach had to abandon the basic form of living i.e. transhumance pasturing what led to found the settlements 'on the Wallachian law'.

15.9. Transformation of transhumance pasturing into shepherding (huts and chalets' economy)

The transhumance shepherding was substituted with a huts economy where the grazing of animals was led by professional shepherds and was a seasonal job. The huts economy had organized the summer grazing on common highland pastures with parallel individual pasturing in the rest time of the year at the own pasture (by the animal owner). According to Jawor [2004] the alps (połoniny) of Bieszczady Mountains were used by the Wallachian shepherds coming from long distance Wallachian settlements of Sanockie county (Szczawne) when the inhabitants of Binczarowa and Bogusza located near Grybów hills had the privilege of free pasturing and threes cutting in the forests near Piwniczna [Kłapyta 2014]. Also, contemporary existing village – Zawoja was, at the end of the XVIth century, a part of territories for pasturing for Skawnica hut (Skawnica Górna). Despite their mobility and expansion, the Wallach was the gentle people and were easily assimilated with the local civilians of Ruthenians, Hungarian, Polish, Slovak, and Chechen people although the Polish chronicler Jan Długosz ascribed them the violent lifestyle, barbarian customs and subsisting from shepherding and the preferable settling in the mountain [Obara-Pawłowska 2017]. The Wallachs were occupied with transhumance of cattle from Ukraine to western Poland where the cattle was sold on the free markets and as shepherds and breeders were specialists in animal castration. The remnant of that is the name of the castrated horse (in Polish) – 'wałach'; the name of the procedure of castration – 'wałaszenie' (gelding) and of the person performing the treatment (wałasznik, wałachar, wałachaj, wałaszajnik). They also were serving as the border guards and controlled – guarding the strategic trespasses through the mountains, defending the merchants against villains and robbers; they were carrying mail, controlling the duty payments for pasturing in the pastures of the hills, etc. [Kłapyta 2014].

The oldest Wallachian settlements in Rus were located in 70ties of the XIVth century in the Sanok and Sambor counties near the strategically important Carpathian trespasses (Radoszycka, Łupkowska, Ruskie Wrota, Beskid) [Kłapyta 2014]. The military reasons explain also the XVth century locations of the three villages on the border of Orava and Liptov (Valašska Dubova, Kňažia and Medzibrodie) [Kłapyta 2014].

The location of cottages on the 'raw root' caused that the Wallachs were cutting out and burning forests to found the areas for pastures on the slop and on hills and near the main (wide) valleys. The names of the Polish Mountain range 'Gorce' are the most probably originating from the above-described procedure of burning (from the old Polish word 'gorze' – is burning).

Contemporary Wallachs live in the areas (in as small islands shape communities) from the middle of Greece (Thesalia), through the mountain regions of Epir and Pindos; in Albania, Macedonia, Serbia to Croatia (Istria) and to the east in Bulgaria and southern Romania (Dobrudża) [Nowicki 1998, Kłapyta 2014].

15.10. The indicator of shepherding economy in the Carpathian Mountains – nowadays existing the Wallachian law located settlements and places with specific geographic characteristic

The Wallach expansion brought to the Carpathian mountains the highlands system of shepherding and pasturing – the shepherds-hut economy, the production of Wallach cheeses, the animals breed suitable for living in the difficult mountain conditions – mainly the sheep of Zackel breed (Valaška, Transylvanian, Podhalańska Raczka Curkana, Cigája); the goats (Carpathian Mountain breed); the cattle (the Red Cattle), horses (the Hutsuls Horse), the breeding nomenclature, specific dialect words, the names of certain places in the mountains; the names of local settlements located 'on the Wallachian law' and the characteristic houses architecture and specific fashion of clothes. The Wallach settlements still with origin names (in Poland from east to west); Żurawnica, Wola Lipska, Huszczka Wołoska, Olszanka, Żdżanne, Hniszów, Stulno, Łukówek, Bereść, Samarowice, Chrzanów, Goraj, Branew Wołowska, Radzięcin, Bircza, Jamna Dolna, Jamna Górna, Trójca, Kopysno, Brylińce, Cisowa, Makowa, Nowe Sady, Sarny, Podbórz, Sokola, Bonów, Bolanowice, Dziewięczyce, Olszany, Czaple, Hubice, Pacław, Smolnia, Starzawa, Terło, Rudawka, Krościenko, Strzelbice, Bilicz, Lenina, Mszaniec, Łużek Górny, Strzyłki, Wołcze, Jasienica Zamkowa, Topolnica, Łużek Dolny, Żupanie, Matków, Wysocko Wyżne, Komarniki, Wysocko Niżne, Ilniczek, Ilnik, Turka, Isaje, Jawora, Turze, Tuchla, Skole, Synowódzko Niżne, Synowódzko Wyżne, Stynawa Wyżna, Tustanowice, Żulin, Borysław, Podhoradec, Kłodnica, Michałowice, Kobło, Wola Derewna, Derewno, Stronna, Łukawica, Manasterzec, Wola Błażowska, Nowoszyce, Czerchawa, Wola, Stupnica, Kotów, Urosz, Wolsza, Łastówki, Podbuż, Jasienica Solna, Uliczno, Solec, Horucko, Letnia, Hubice, Bolechowice, Medenice, Poczajowice, Bilcze, Delawa, Wownia, Dziurdziów, Trzcianka, Bandrów, Jaśliska, Wola Sękowa, Odrzechowa, Końskie, Hłomcza, Witryłów, Łubno, Hadle Szklarskie, Rudawka Rymanowska, Żohatyn, Lipa, Leszczawa, Brzeżawa, Tyrawa

Wołoska, Bezmichowa, Serednica, Stefkowa, Ustianowa, Olszanica, Uherce, Bóbrka, Chrewt, Polana, Żurawin, Tarnawa Dolna, Wola, Tworylne, Rajskie, Smolnik, Wołkowyja, Solina, Mchawa, Serednie, Zahoczewie, Łukowe, Wola Czaszyńska, Czaszyn, Markowce, Niebieszczany, Morochów, Wola Morochowska, Płonna, Szczawne, Radoszyce, Ochotnica, Szczawnik, Zubrzyk, Krynica, Izby, Mosty Jabłonkowskie, Jachówka, Trzebunia, Bieńkówka, Zawoja, Istebna, Porąbka, Rzyki, Kaczyna, Ponikiew and Koziniec.

The Wallachian origin has the subsequent names: Groń, Gronik (from 'grui' – hill, top, dome-like hill), Kiczora, Kiczera – from 'chica' – bristle. 'Chicera' is a bristled hill and the popular name in the Carpathian region from Transylvania to Moravian Valasska. Kotelnica from 'kocić' – the place where sheep gave birth to lambs or from name 'hotar' – the border of ownership, the border sign. The Kotelnica village is located in the place where the borders of the three villages have the common point – Ochotnica, Szlembark, and Huby. The name of village Kosarzyska – from 'coşar' barn. The name of the village and geographical locations: Magura, Magurki from 'măgura' – free located or clearly distinguished mountain range. The name of village Maniowy – from „Manea" – the Latin woman name. The name of village Murzasichle – from the combination of two cottages names: Mur and Zasichle. The town name – Muszyna, Muszyny – from 'muschi' moss. The Przysłop – from 'prislop, prislopul' mountain saddle. The Beskid (mountains) – from 'bjeska' alps meadow. The Rzepedź – from the fast water (river) current. The Turbacz (mountain) – from turf, peat. The Zawoja village name – from the by the river coppice [Mulet 2012].

In Beskid Żywiecki exists many tops of the hills, slopes, and other places which names are of Wallachian origin. The names of Kiczora, Kiczera, Kiczorka, Kocierz (the hill in Beskid Mały, and village in Łękawica municipality) are often found there. Also, the names of Kotar, Kotarz, Kotarnica, Kocoń and Kaczyna are similar to the above origin. The present in Beskid Mountains names for tops are Magura or Magurka and are describing dome-like mountain's top. Menczoł, Minczoł, Mończolik are also from the same source and describe a big forested top-dome hill.

The village name Praszywka in Velka Raca range origin from Wallachian 'praszit' plow. The Redykalna Hala from the shepherd's word 'redyk' (the transhumance shoot of sheep into the mountains). The name of place Romanka and the family name Roman origin from the popular description of Wallach origin – from Romania (Rumunia). The name of tops of hills and villages – Szyndzielnia from 'szindrila' shindle. The names of Wołosate, Wołosianka, Wołosinowa, Wołosice, Wołochówka, Wołoszyn, Hala Wołoszyńska, Wołosaty, Wołosatka origin from word Wołoch (Wallach, Vlach).

The movements of Wallach shepherds are certified by the repeated names of mountains, alps, clearings, meadows, and municipalities in Beskid which can be also found in Romania and in the western part of the Carpathian Mountains. The perfect example are the names from Beskid Mały of such villages as Ponikiew (near Wadowice) and Ponikiew in Miedzybrodzie Bielskie; Zembrzyce (near Sucha Beskidzka town)

– Zubrzyc (in the XVth century) is the counterpart of Zubrzyca in Orava. It allows for the conclusion that when a group of shepherds had exploited a certain land it moved further and named a new place with the old, former name [http://www.beskidmaly.pl].

Some other examples of names originating from Wallach in Beskid Mały are: beskid – the meadow or alp in the mountains; carchel (the settlement near Żurawica and name of mountain pass there); Cerchla – the village in Miedzybrodzie Bielskie; the mountain peak Kocierz (879 a.s.l) and municipalities Kocierz Rychwałdzki, Kocierz Moszczanicki, Kocoń, Kaczyna. The name of village Praciaki origins from Romanian porc – pig – the region was inhabited by Wallach occupied with pigs breeding. The names like: Ponikiew, Smrekowica, Mlada Hora, Złota Górka, Leskowiec or Kobyla Głowa also came with Wallach to Beskid Mały but their origin is from Chechia and Slovakia [http://www.beskidmaly.pl].

15.11. Loanwords from the Walachian language in the family names

The numerous family names in the sub hills of Beskid are of Wallach's origin: Wałach, Włoch, Wołoch, Walas, Wolas, Walaszek, Roman, Romańczyk, Wojewoda, Wajda, Wojewodzic, Gajda, Bajda, Batko, Wajdzik, Wojdyło, Wojtyła, Baca, Bandoła, Magiera, Gurdek, Gielata, Bryja, Byrdy, Bryndza, Putyra.

In Orava the counterparts of Wallach's origin are: Buła, Bryndza, Byrdziak, Byrski, Burdyl, Butor, Danek, Foltyn, Fifek, Gałuszka, Gawryś, Holewa , Hutyra, Kojder, Kuźma, Madej, Oleksy, Paleczny, Ramza, Rajda, Sumera, Cibor, Tomala [Woźniak 2013].

The above family names are still in usage and have spread to the whole of Poland.

15.12. The dialect of Gorols of Walachian origin

The Wallachian origin is also words such as gajdy – dudy – bagpipes; gazda – gospodarz – farmer; gieleta – a big wooden pot for milking of ewes; gunia – the outer Gorols coat; hajduk – reaver; harnaś – the chief of ravers; hyr – sława – fame; juhas – the minor shepherd in the hut, baca's helper; koliba – the shepherd's chalet'; koszar – the movable pen for sheep; młaka – bagno – marsch. The Wallachian origin has almost all Gorols dialect descriptions combined with pasturing and they concern persons (baca, juhas, honielnik), the shepherds' products (bundz, bryndza, ser klagany), the clothes (gunia, kożuch), the work equipment (gieleta, ferula, pucierka) the buildings (koliba, szałas, koszar) or actions (redyk, strąg) [Drozdowski 1961, Kopiczyńska-Jaworska 1969].

Koliba – chalet (from coliba), similarly like szałas – hut (from sălaş) is a house and at the same time a barn for shepherds constructed in the mountains. Koszar – pen (from coşar) the movable barier for sheep; kocoń – cattle pen (from cocin) and strąga (from strungd, sztrunge) – a part of pen for sheep dived from others, used during sheep milking. Redyk – shoot (from redyk) – the spring shoot of sheep towards long distant pastures (alps) and also the animals return to the valley for the wintertime; runek – the meadow (from runc) – the alp meadow for pasturing; mierzerzysko (from mieredzać) – small, shadowed alp where the herds were resting during hot days; solnisko (from sól) – the place where the salt for sheep, goats and cattle herds was placed (a small spot on the alp-meadow near the forest border); wydziorek – water source (from izvor); młaka – marsh (from mlaca) and kotarnia – the border of ownership (from hotar), the border sign [Mulet 2012].

15.13. Traditional Gorols redyk – reminiscence of the transhumanace traditions in different parts of the Carpathian Mountains

The sheep present nowadays in the whole range of the Carpathian Mountains origin from the same, old breed of Zackel which was brought from the south of Europe with Wallach. The customs of breeding and shepherding are of a similar origin and are adjusted to the rhythm of 'shepherd's economy' and seasons of the year. The base of Wallach shepherd's economy was transhumance (French 'La transhumance') – the kind of pasturing based on the systematic seasonal shoot of sheep and goat's herds, rarely of the cattle from lowland pastures towards highland alps. The Wallachian ways of housekeeping allowed for the breeding of animals even in the hardest land and climate conditions. The winter season finished in the second half of April when the herds were moved for summer pasture. In the tradition of Polish Gorols as the beginning of the season was the 23rd of April, the St. Adalbert's Day – the saint patron of shepherds. On this day the shepherds participated in a festive Holy Mass, and this was the beginning of moving herds from cottage towards the summer pastures. The pasturing was started by mixing of sheep (animals were taken from different barns of the village and joined into one, big herd) [Kiwior 2018].

The autumn return (autumn redyk) was in the St. Michaels day (29th of September). The return was not a great festivity and was called 'uosod' ('uozchod') from the word meaning the division of sheep to the individual farms (barns) of their owners. The early spring individual pasturing is called 'przepaska' (pre-feeding) and autumn 'jesionka'. Because after autumn redyk the sheep were returned to the owner ('gazda') their further feeding was individual or sometimes the sheep were kept by the shepherds chief – baca for 'jesionka' grazing. The autumn pasturage was performed till the first frosts and the snow falls on the meadows and fields in the village [Rosiek 2007].

In the Hutsuls lands the shepherds' tradition was ruled by the Julian calendar and according to it the 6th of May, where the Day of St. George (Św. Jura) was the symbolic date for the start of wandering with animals to the alps. The shoot there started in the St. Nicolas of the Miracle when the summer shepherding begun. That data is the patronage holiday for all Carpathian shepherds. It is believed that the Christian St. Nicolas replaced the former, pagan god Wełes (Wołos) who guarded the cattle from wild animals. The Hutsuls parochs priests blessed the salt (for animals) and cow's milk on that day. The festive and official beginning of the shepherding season (in Hutsuls lands) took place at the turn of May and June. The event is called till today 'połoninski chid'. The possibility of pasturing herds in mountains alps was depending on snow vanishing and the condition of meadows. Also, at that time, the sampling of milking yield was performed, called 'podaj na miru'. The aim of the action was checking of milking yield for the pasturing season [Gudowski 2001, Kubit 2011]. On the 1st of October (14th in Gregorian calendar) the shoot (redyk) was finished. The shepherds came back with the herds in a festive parade, warmly welcomed by the whole municipality – the 'osinnij połonyńskyj chid'. The coming, to the village, shepherds were handing the small handmade cheese figurines of animals (syrowe konyky) to children and girls. Then the 'osod' took place – the sheep were returned to owners and 'watachowie' ('bacowie' – the major, chief shepherds) were reckoning up with farmers ('gazda'). The sheep were pastured then till the first snowfall in the meadows near the village and then shoot them to so-called 'winter place' – the meadows where the barns were built. In the barns, sheep were resting and giving birth to the lambs. They were fed with hay gathered and dried during summer and stocked under the roof of the barn [https://szlakwoloski.eu/... /obrzedowosckulturypasterskiej]. The local names of sheep kept in Hutsuls lands were: dołhorunna, habesta, Sahaja, karakułka, and Czerwinski [Kosiek 2001].

In Silesia, the owners of pastures and sheep organized huts in the spring (hut – here was a kind of community bounded to the area and subjected to certain, specific rules). The main chief of the hut –'szałasznik' was elected from the village farmers and he had to find and employ the shepherds, to control work in the hut, keep an eye on dairy products selling, and division of incomes, etc. His role was also to establish the day of the shoot into the mountains chalet. On that day, usually in the middle of May (the patronage day of St. Sophia, the 15th May), the mixing of sheep took place (into common herd). Exceptionally, when the spring came late and the temperatures outside were low the grass vegetation was retarded then the shoot was performed in the Sending of the Holy Ghost ('green holidays') [Kopczyńska-Jaworska 1961]. The farmers brought sheep to the pasture and there the division and queue of cheeses obtaining and the division of costs of common hut leading was discussed. The time of pasturing was 19–20 weeks – the end in the second half of September.

On the day of 'rossad', usually on the day of St. Michael (the 29th of September) the farmers were coming to the mountain hut and take their sheep to the village. There, in the village, the animals were pastured 'na gruncie' – in the arable fields where the crops had been already gathered. During the cool nights, the animals were taken to the barns.

Because of rather small stocks of hay in the village, they were not sufficient to fed animals through the whole winter so after the 1st of November the farmers were sending the shepherds with sheep to special pits ('na doły'). The shepherds gathered sheep from a few farmers (at about 100 to 150 sticks) into one herd. Then the autumn shoot started, which, on average, ended at the end of the year. Then the sheep were returning to the home villages. The sheep stayed in the village for a few days and each owner-farmer walked them to the winter spot into the mountains. The winter sports were clearings where the sheep barns were built. The sheep barns were constructed from wood bound with quoin angel covered with shingle. There was not a floor in the barn and under the roof, the hay gathered in summer was stocked. The winter spot-huts ('zimiarki') were still kept (as architecture monuments) in Brenna (Równica hill), in Skałka, in Bukowy Groń, in Mała Czantoria (a hill near Ustroń town).

The sheep are left in the hut alone for the night. Every morning, at about nine o'clock, the guarding shepherds are coming and stay till night. The shepherd strews the fresh bedding, gives the hay and salt. If the weather is fine the sheep are allowed out and fed (on the snow) with branches of spruces and firs or shoots them to the closest forest, where the animals crop 'borownik' – the forest undergrowth or eat juniper branches. After the feeding and watering of animals, the shepherd comes back home. The heaviest shepherds work starts in March when the sheep are giving birth to the lambs. When the lambing is in peak the shepherd stays in the hut with animals all the time. Also, the hay runs out at this time so the shepherds prepare to go with sheep again downhills towards the so-called 'jarowisko' spot. In the abandoned huts in the hills, the organic refuse fertilizer is left and then used for grass fertilization at the meadow. The sheep return to the village at the end of April when the time to go towards mountain huts is coming [Kopczyńska-Jaworska 1961].

In Żywiecki Beskid the march of sheep towards alps and their return was performed in stages. The first, spring, place of grazing, during 3–4 weeks, were 'spodki' (the meadows and forests clearings) belonging to the individual huts (szałas, chalet). From the day of Holy Body Christian holiday till the day of Our Lady of Flowers (the 15th of August) the sheep were grazing in the alp, and from the second half of August, the animals were pastured again in the 'spodki' (after crops and grass for hay harvests) till the St. Michaels day. Also, the day of the week was important for the start of animals shoot to the hills – the possible days were Monday, Wednesday, and Saturday; Friday and Sunday were forbidden. Before the start of wandering towards the alps baca (the chief shepherd) was sprinkling sheep with the holy water (blessed by a priest) and waved the cross sign over animals or these holy activities were performed by the sheep owners-farmers in their individual barns. When shepherds were wandering with a gathered herd of sheep through the village the young girls were sprinkling them with water to withstand them from sleeping during pasturing, because they were employed to guard the stock against wild animals, especially wolves. The main organizer and responsible person for the summer root of sheep was baca (the chief shepherd) who was the most experienced and respectful in the village.

15.14. The everyday life in individual small hut economy

Often the owner of the whole alp meadow or co-owner was baca (the chief shepherd) where he performed the transhumance of own sheep and gathered from the villages. The baca aquired his incomes almost only from cheese making and dairy production, and sometimes also disposed of some wool for own purposes. The payments for pasturing changed depending on cheese price in the year of calculation. The most universal and applied rate was 4 kg of cheese for the owner of entrusted sheep [Rosiek 2007]. During pasturing the chief shepherd needed some help shepherds who were chosen by him from the villagers. These shepherds who were liable to baca directly were called 'juhas' and they were milking ewes; the rest of shepherds who were occupied with less important activities were called pandar or sheepman ('naganiacz', 'owczarz').

In the Tatra Mountains, the sheep are pastured by juhas (lamb chops), whereas in Żywiecki Beskid, where to the hut also were taken cows (and former oxen) the shepherds were sheepmen, cowmen, and ox men. The long years' experience of work in the mountain hut in the alps started from baca helper position named 'hulajnik' or 'honielnik', subsequently the helper can become sheep man or cows man or ox man. The baca's choice of the helper was an ennoblement and although was connected with hard work it gave the hope for a good salary and gathering of the necessary experience to become a chief shepherd someday. The helpers were given a salary appropriate to the job position which they occupied in the hut. The chief shepherd had to supply all his workers for the period of five months pasturing with food, clothes, tobacco and to give them a share in the hut production (cheeses). The Żywiec sheep man obtained for the season 100 kg of bryndza, 50 quarts of butter, 2 pairs of kierpce (leather shepherds shoes), and 2 repairing leather pieces ('łatki'), because the shoes were ruined during long wandering and taking care after sheep in the mountains. The cowman obtained 80 kg of bryndza, 40 quarts of butter, and 1 pair of kierpce with one repairing a set of 'łatki' because he was working on the meadows closer to the hut and did not wander with cows into the forest [Rosiek 2007].

The important ability of baca was to possess the magician skills, to repress nature powers, especially in difficult mountain conditions, to know rules of bridling of them. The most important place in the hut was a bonfire – where the whole life of shepherds concentrated – it was warming up the hut, the production of cheeses took place (heating and curdling of milk, smoking of cheeses), the meals were cooked and consumed, and the free time of leisure was spent.

The unique form of mountains' meadows alps and clearings fertilization was 'koszarzenie' (gathering of sheep inside pens at the meadow). The sheep pastured in the poor alps and clearings with the prevailing of worthless, so-called 'dogs grass' (*Nardus stricta* L.) were gathered for the night and for milking time in the movable pen (koszar). The pen was moved every day and the remaining of sheep organic wastage allowed for fertilization and for bettering of the plant cover of the pasture. 'Kosarzenie' is much more than similar organic fertilization through manure distribution on the pasture. The sheep when staying in koszar left their wastage and also tread it into the soil (grass) what lowers the losses of nitrogen. Also, the higher temperature in the koszar, turf, and soil rises the activity of the microflora responsible for soil mineralization. Such a way of fertilization also diminishes washing out of nitrogen from soil because the animals' wastage introduced into the turf is quicker absorbed by the grasses' roots [Drożdż and Twardy 2004].

15.15. Carpathian, traditional cheese-making art

During the cheese-making in the shepherd's hut, the traditional methods and tools inherited from Wallachian ancestors are used. There were and still are produced a few kinds of cheese types in the hut. The production is mainly based on ewe's milk with some addition of cow's milk (from the Red Mountain Cattle). The products are bundz and bryndza – the ewes milk rennet cheeses (not ripened, ripened); żętyca (from 'jintita', 'żintice') – the kind of half liquid nutritious cheese (the ricotta like heat shortened cheese obtained from the whey left after the regular rennet cheese – bundz production); hurda – is a fat żentyca covering the surface of curdling pot during zentyca heating; zwarnica – is a bitter thin żentyca present at the bottom of the pot; oscypek – the specially formed and smoked bundz (rennet cheese); redykołka – the small oscypek of animal shape. There are also specific auxiliary tools and raw materials for cheeses production. Klag (from 'chiag', 'clag'*)* is a rennet obtained from a dried calf stomach and used for milk proteins curdling during cheese production (nowadays the rennet is of microbiological origin) – from there goes the name – klagany ser (rennet cheese). Gieleta (from 'galeata') is a big wooden pot used for sheep milking. Puciera the wider at the top wooden barrel for curd mixing ('klapanie'). Ferula is a wooden mixing tool made of tough wood for curd beating and mixing of puciera content. Oscypiorki ('łupy') the wooden molds for oscypki cheeses making, traditionally made of sycamore wood with the typical for each chief of shepherd's pattern to sign the cheeses. Czerpak the small wooden pot with characteristic long one hand sculptured handle for milk, żentyca, curd with whey, etc. spill. Ferula ('fyrla') the kind of a wooden fork used for cutting of cheese's curd. The set of the copper pot, a wooden rod with the right heating for curdling milk over the watra bonfire. Also, an important element of equipment was 'krzasła' the sub-assembles of wood for the building of sheep pens, 'piesek' (the 3 legs chair used for milking by juhas) and 'podwyszaki' (the shelves for smoking and drying of cheeses placed under the roof of the hut).

At the beginning of pasturing, in the alps, the sheep are milked 3 times a day then (after St. Johns day, the 23rd of June) 2 times and at the end of the season, the sheep are parched and milked only once a day.

The basic product of traditional cheese-making in the Carpathian Mountains is bundz (the soft rennet cheese) from which bryndza is produced (the molded and ripened salty cheese with specific flavor). The scalded and formed with oscypiorki bundz, salted, smoked, or not, was called oscypek – big conical shape cheese (weight 0.3 to 0.4 kg) or if shaped into small forms of animals (20 to 30 g) was named redykołka. The production of oscypek and redykolka according to the traditional recipe where 60% of raw material – milk is of sheep origin (Zackel breed) and up to 40% of milk has to be of Polish Red Cattle origin (Polish Red Cattle – the breed of mountain animals adjusted to the tough climate and hard wandering conditions – the light meat-milk utility animals) is only sustained in the western part of Żywiec area, near Babia Góra (Beskid Mountains), in Gorce Mountains and Podhale (the sub mountain hills of the Tatra Mountains range) [Kopczyńska-Jaworska 1961]. These cheeses are listed on the European Traditional Products List and signed with PDO (protected design of origin) mark so are protected from faking and adulterations and can be made and sold in the precisely listed conditions. Also, the second 'production line' of rennet cheeses is present in Gorce and Wyspowy Beskid – they are called 'brus' [Kopczyńska-Jaworska 1960].

15.16. The cross-border specific way of building as the heritage of common traditional architecture

Among the Carpathian Gorols living both from the southern and northern part of the mountain range, a few cultural characteristics can be found which have the common origin and character. The similarities are observed in the construction of buildings, pasturing tools, in the technology of obtaining and processing of milk, sheep pelages, and wool usage expanded ceremonial rites connected to pasturing and some clothes elements: ‘kożuch’ – wool-fell, ‘serdak’ – jerkin, ‘sweter’ – sweater, ‘kierpce’ – leather shoes with special binding elements. The characteristic is white sheep wool trousers with the embroidered ornament of ‘parzenica’ – the element found everywhere at Wallachian ancestor’s clothes from Balkans to Moravia (in Chechia).

The houses built by Wallach had a characteristic shape (architecture) and the dominating element which differed them from houses in municipalities located on the German or Polish law is the roof construction. The Wallachian roof is very steep with short lines of the rooftop – in the profile looks like a sharp conus. The second characteristic of the Wallachian roof is the formation of eaves. The rafters are supported by horizontal beams put out the wall and from the eaves around the house covered with planks from the bottom [Środulska-Wielgus and Wielgus 2018]. The common heritage of Wallach is also star (‘gwiazda’, ‘cyrhlica’) named also the flower of life, Carpathian rosette, Podhale rosette, six-arms rosette – which in many cultures was perceived to be magic. This a six-pointed star – the geometric ornament of the six-arms rosette – is formed from a sexpartite flower imprinted in the circle with the band, sometimes combined from a few inflict-penetrating each other rosettes. This decorative element is placed on the roof foundation of houses, on furniture and also as an element of jewelry – brooches, tie-pins among heads of birds, eyes of birds, crosses, edge brinks, triangle apophyse, geometric motives, shapes of sun, stars or moon. The star is the most common decorative element of the roof foundation placed on the central ceiling beam in the house [Antoniewicz et al. 1966].

15.17. The construction of shepherds’ huts and tools

The main building in the mountain alp was Shepherd hut. In the Tatra Mountains and submountain areas the hut was called ‘koleba’ (‘koliba’) or bacówka and in Slovakia, the name of koszar was used. The name referred to the building where people were living, the other buildings were called barns or sheds [Kurek 2016]. In Gorce mountains, the names as ‘koleba’, ‘bacówka’, ‘izbica’, ‘okoł’, ‘koleba z jatą’ were used [Cieszkowski and Luboński 2004]. The hut, first of all, was the place of dairy products production, but also was a place for living and its construction was kept according to the rules of traditional building. In Żywiec area koleba was the squared building of regular foundation covered with a gabled shingle roof. But also the lighter constructions were found of sokha shape foundation or frame shape foundation what allowed to move them to another place. The hut had not floors nor ceilings. The slits between beams or planks were not tightened because of the necessity of building ventilation. There was constantly burning the watra fire and the cheeses were fermenting. The primitive buildings serving for protection of shepherds who directly guarded sheep were shacks. The pen for animals was built from pigtail fences so-called ‘krzaseł’ in the form of two parts. For milking purposes, the plank from the inner fence was pulled out forming the whole called ‘stronga’. The sheep were gathered in one part of the pen and were entering the second part one by one and near the whole, they were kept and milked. The pen (‘koszar’) was built from only natural materials, there were not present nails or wires to avoid thunderstorm bolts striking.

In the hut beside the watra fire the pots and tools connected to dairy production were placed:

- for milking gielety and skopce (wooden pots),
- large troughs for cream gathering from milk surface,
- ‘bazarnie’ the large pots for cream storage and large butter churn,
- the copper pot for milk heating with ‘czerpaki’ and ‘cioski’ (wooden pots of different shapes) for curdling and beating of curd,
- ‘grudziarka’ – the linen material for sieving of curd,
- ‘puciery’ – pots for cheeses storage (i.e. sweet rennet curd forming bundz),
- the balance,
- ‘kamarnik’ – the shelf where cheeses were ripening.

The pots where the milk was stored were made of sycamore the other pots could be made of pine wood; mostly pots were made of staves, whereas troughs were tinkered form three trunks. Also, the special ‘mosorowe’ pots were used – tinkered from the spruce trunk which was subjected to the special process of rotting. Also, there were benches, stools, and primitive bunks for sleeping; often shepherds slept on bags filled with straw [Oddział Górali Śląskich ZP 2009].

15.18. The Carpathian Mountains craft and culture

The important element of mountaineer’s culture was and still is an art and craft. To produce the traditional tools and some everyday used equipment the commonly available raw materials were applied it means wood (for carpentry, barrels-making) and wool (spinning, cradling, weaving, and knitting). Also, for processing of wool were used fuller to produce baize through wool felting. In the Piwniczna county region, a few fullers were placed. The machines were powered by running rivers water. The last one fuller was working till 1934 in Kosarzyska village on the river Czercz. The linen string was also produced and used for laces and canvas making [after Kubiak and Molik 2019]. To the craft also the production of pastoral musical instruments was included. At the beginning those were the primitive instruments serving for communication between shepherds who were pasturing herds on distant alps, then the instruments evolved and started to be a part of folklore music typical for each shepherding community. The first specific instrument was wooden trumpets (‘trombity’) well known in the all Carpathian Mountains range. That instrument depending on the place was a bit different in shape near Limanowa and Piwniczna villages similarly like in the Podhale region they were short or medium-long, whereas in other places even four meters long. The next, but the less common instrument was horn. All kinds of pipes were used (i.e. the ancient six-hole single pipe without bottom, very difficult to play on) and clay ocarinas. The very simple instrument could be at that time also the biological materials i.e. leaves. Also, in the area, the ‘koza’ pipe was used (bagpipe) – the wind instrument composed from an air reservoir made of goat’s (or sheep) skin and a few pipes. There were present some string instruments as ‘złubcoki’, ‘gęśl’e (primitive fiddles) and violins, and bass. The culture of shepherds also contained songs and ‘łozywanie’ (incantation), used for communication between boys and girls working in the fields. The incantations differ depending on the part of the Carpathian Mountains range [Cząstka-Kłapyta 2012, Kubiak and Molik 2019].

15.19. The Hutsuls’ horse as the main power for transport and farming

It is difficult to imagine Wallach people moving along mountains, for a long-distance without the help of horses needed for the transport of people and goods. These animals are especially identified with the northern-east area of Wallachian colonization – the Bukovina (in Moldova) – the Hutsuls place. They especially appreciate the small Carpathian horse – the Hutsuls horse.

In their native place, Hutsuls land, the horses were outside all year long (in alps) only during the heavy winters were sheltered in some primitive barns. During the winter they were fed with hay from stacks placed on the mountain meadows, whereas in the summer with poor grass from clearings in hills. Only the heavy-duty horses were fed with oat grains. That way of breeding and constant living in the difficult, severe mountain conditions, outside, movements in the rocky territories and long marches with heavy load packs accustomed the horses through generations and formed their health, immunity, longevity, and with not refined fed demands. The Hutsuls horses were very important in every day Hutsuls people’s life. The long distances inherited rich imagination, passion for horses made the whole community ride on horses. The Hutsuls horse was a human irreplaceable companion and friend used as ridable, pack, or draught animal. The above way of usage during long years made the nice, calm with balanced character, smart, patient, persistent, and longlived animal.

The first description of this animal, in 1603, was done by the Marshall Christopher Dorohostajski in the work *Hippica*. The originating from Hutsuls land horse was wider appreciated and in 1924 Mr. Michael Hollander initiated the registration of mares and origin of the Society of Hutsuls Horses Breeders. Nowadays the register of mares and stallions is done through the Stock Book of Hutsuls Horses and the breeders and fans of these animals are registered in the Polish Society of Hutsuls Horse Breeders [Bordzoł and Jackowski 2008]. The important centres of hutsuls horses breeding are in Luczina (Romania), Topoľčianky Národný žrebčín (Slovakia), Aggtelek National Park (Hungary), Poloninskie Husbandry in Prelukah (Ukraine) and Stadnina Koni (stud farm) 'Gładyszów' in Regietów (Poland), the Experimental Facility of Zootechnics Institute in Odrzechowa (Poland), Bieszczadzki National Park (Preservative Breeding of Hutsuls Horses in Wołosate in Poland), Serednie Małe (Poland), 'Tabun' in Polana (Poland)', Stadnina Koni (stud farm) Huculskich in Hawłowice (Poland).

The first organized centre of Hutsuls horses breeding was created in Bukovina, in 1856, the State Stud Farm of Horses in Łuczyna. The first attempt of organized breeding in Polish land took place at the beginning of the XXth century. There were organized, in Galicia the shows of those horses and the first barns of stallions were found and the registration of mares was performed in Hutsuls lands. The outstanding characteristics of Hutsuls horses and their economic suitability were appreciated by breeders of Hutsuls lands who found, in 1925, in Kosovo, the Society of Hutsuls Horses Breeders. The 2nd World War was tragic for stocks of these horses – only a few mares and stallions survived. The breeding work had to be started from the very beginning. After a few movements and reorganizations, the breeding of Hutsuls horses was moved to the State Stud Farm in Siary in 1958 [Brzeski et al. 1988]. In 1985 the stud farm was moved to Gładyszów and was erected the new state stud farm in Zootechnics Experimental Facility in Odrzechowa, where 14 mares and 2 stallions were bought between 1986–1989 [Bordzoł and Jackowski 2008].

In the beginning, the small Carpathian horses were used in the Podhale region as a packing force in the farms and to bring milk and dairy from hill huts. As long as in the 70ties to 90ties of the XXth century the Hutsuls horses were used for peasants' carts to carry the equipment to huts during spring shoot of sheep into mountains huts. Before the railway between Kraków and Zakopane was built the whole transportation of goods and tourists was performed with the horse's help. The carriages used for transportation had different shapes and construction ('pólkoski', 'fasiągi' – for goods transportations, carriages for people transportation). Also, the specific carriages were constructed in the sub-mountains region like in Podhale – the 'kumoterki' (the winter carriages on skids).

The Polish horse (Hutsuls, Polish cool-blooded horse) has a wide application in the forests for logrolling of threes, during pasturing in hills also as the animal pasturing for landscape sustaining. The horse still serves as ridding on the animal during forest patrols, hunting, and police interventions [Zawiślak et al. 2014].

15.20. Conclusion

To recollect the heritage of the Wallach and to remember all the brilliant and valuable goods, habits, customs, and culture brought and built during Wallach migration in 2013 was organized the exceptional Carpathian Redyk – Transhumance 2013. The amount of 300 sheep with shepherd's dogs, donkeys, horses was shoot. The shepherds wandered with the herds for 1200 km (each day 15 km). The route was leading along the Carpathian Mountains from Romania (Rotbav, Brasov region) through Ukraine, Poland, Slovakia and finished in Chechia (Moravia). The aim was to gather people living and working in mountains and hills of the Carpathian Mountains range to show the rich heritage of lands and nations, unique nature and way for balanced and sustainable development of the mountain's regions. One of the leaders who brought and realized the idea was Mr. Piotr Kohut from Koniaków – one of the last ancestors of Wallachian heritage [http://seroscypek.pl/atrakcje/redyk-karpacki].

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16

Polish native animal breeds as bio-indicators of natural heritage

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Abstract. Polish Red (PR) cattle is the oldest and the only existing indigenous cattle breed in Poland. The herds of this dual-purpose breed are protected by the Genetic Resources Conservation Program. Polish Red cows are relatively small animals, with very good adaptability to tough environmental mountain conditions, fertility, and resistance against diseases. Milk yield is lower when compared to the high-yielding cows of the more popular breeds, but is characterized by the high protein and fat content as well as biological and technological value. Polish Mountain Sheep (with a white or dark-brown coloured coat) is genetically well adapted to harsh mountain climate crossbreed of Podhale Zackel with Frisian rams and Zackel from Transylvania. This breed gives good milk yield with chemical composition particularly suitable for cheese production and high-quality lambs' meat. Lamb from Polish Mountain Sheep from the Podhale region, due to excellent organoleptic and physicochemical properties, such as soft, elastic structure, delicate, specific flavour similar to the game, low-fat content, etc. has been awarded Protected Geographical Indication under the name 'Jagnięcina Podhalańska' since 2012. Milk from both Polish Red cows and Polish Mountain sheep is the only permitted source milk for production of regional Bryndza Podhalańska, Oscypek, and Redykołka cheeses certified with European Protected Designation of Origin (PDO) indication. Traditional grazing with local breeds on the unpolluted mountain pastures rich in a variety of flora, including endemic plant species influences unique characteristics and high quality of the milk and meat products. It constitutes also material and intangible heritage of the Podhale region as pasturing together with the production of milk, cheese, wool, and leather has an old tradition dating back to at least 15th century. This tradition is also reflected in local architecture, regional products, art, dialect, costumes, ceremonies, and beliefs. Animals grazed on pastures not only constitute an integral part of the region's landscape but they also are an important factor that creates it.

Keywords: Polish Red cattle • Polish Mountain Sheep • Podhale region

16.1. Introduction

Local, native animal breeds present at a certain area, and their usage for traditional food production can be the meaningful cultural heritage indicators, and parallel they can favor the economic development of the region. The local breeds although their lower productivity, get used to environmental conditions, so they are more resistant to diseases, long-lived, and products obtained from them are of better quality. These breeds are also the precious reservoir of genes. The examples of such native breeds in Malopolska voivodeship are Polish Red Cattle (PR) and Polish Mountain Sheep kept in the Beskidy Mountains region and the Carpathian Goat breed [Barłowska 2011, Sikora and Kawęcka 2015]. The local breeds, such as PR, favor, from the first side, keeping of biodiversity – they are subjected to genes reservoir protection project, and from the other side they ease obtaining milk and beef of outstanding quality because these animals are fed with farm-grown volume feeds [Adamczyk and Szarek 2009]. The results of research point that milk obtained from cows using green pastures are characterized by better parameters for cheeses production and is also richer in components well influencing human health, especially they are richer in whey proteins, polyunsaturated fatty acids, CLA among others, and vitamins dissolved in fats [Barłowska et al. 2012].

16.2. Polish Red Cattle

Among native cattle breeds – the Polish Red Cattle is perceived as a single autochthonic breed bred in Poland. The PR origins from small brachiceric urus – Bos Taurus brachyceros [Holm and Wójcik 2005]. The PR is a native breed that had been raised in large areas of the country, mainly in southern Poland, but also in Lublin voivodeship, in north-eastern Poland and Lower Silesia (near Rawicz town). That cattle, with its milk-meat type, is characterized by a big vitality, good health condition, very good fertility, longevity, outstanding against diseases resistance, especially against tuberculosis and perfect adaptation to difficult living conditions [Gądek 1998, Litwińczuk and Kamieniecki 2005, Klupczyński et al. 2005, Ziemiński 2005]. Nowadays the PR cattle is kept in central and southern part of Malopolska voivodeship, namely in Limanowski, Myślenicki, Nowosądecki and Nowotarski counties [Zdebska 2005].

In 1983 there were established three preservative herds of PR cattle in Hańczowa near Uście Gorlickie, in Institute of Genetics and Animals Breeding of Polish Academy of Science in Jastrzębiec (Popielno barn) and Ełk. The number of cows was 280 animals. Now the genetic reserve is herd in Ecological Agriculture and Animal Breeding Research Station of Polish Academy of Science in Popieln and at about 500 cows chosen in Pogórze Karpackie (Carpathian Submountain area) in farms and large barns in Jodłownik and Szczyrzyc in Limanowski county [Żukowski and Trela 2005]

The Polish Red cattle are subjected to the protection of the genetic resources program. From 2002 the program is led by the Institute of Zootechnics in Krakow, Poland. Contemporary in PR breeding the two programs are present: a program of genetic breed improvement (basic one) and program of genetic resources protection. The amount of cows of PR breed is estimated for at about 30.000 cows, whereas only 500 was protected by genetic resources protection program (in the year 2005). As the main tasks of the program are reconstruction and conservation of old PR cattle population and keeping up of existing genetic diversity. The breeding work is forwarded to keep of typical characteristics of that cattle, such as perfect adjustment to difficult environmental conditions, high immunity, and diseases resistance, very good fertility, easy calving, high longevity of calves and ease of rearing and high biological value of milk [Stopyra et al. 2005].

In 2009 the program of genetic resources protection was concerned with 1760 cows. In 2008 the average milk yield of cows subjected to milk utility control was 3927 kg of milk with 3.35% of protein and 4.25% of fat contents. Unfortunately, the stock of PR cows drops down. The cause is the low milk yield of PR cows that was caused by insemination with the semen of bulls of the old type of PR cattle breed. The lowering of cows' milk yield causes that the breeders do not acquire the program of genetic resources protection because the surcharge (additional payment) in the program does not cover losses originating from lower milk yield [Adamczyk and Szarek 2009].

Nowadays breed pedigree in Poland for Polish Red Cattle is as follows [Adamczyk and Szarek 2009, Krupiński 2012]:

- meat-milk type of usage,
- the high in the lower back of adult animals: bulls – at about 140 cm; cows at about 130 cm,
- coloring uniform from red to dark red, cherry; with dark hooves and nostrils (with the possible light muzzle), light horns with dark ends,

- the build characteristics – properly constructed horns and hooves and streaming to udder building improvement,
- the average yield of cows protected within genetic resources program is at about 3500 kg per lactation, with fat content from 4.2 to 4.5% and protein content from 3.3 to 3.6%.

The Polish Red Cattle gives the milk of outstanding quality with high protein content and fat which contains polyunsaturated fatty acids of ώ-3 and ώ-6 families. That milk is especially suitable for cheeses production [Adamczyk and Szarek 2009].

Nowadays, breeders' efforts in breeding and genetics areas are directed to obtain milk with high protein quality and to the lesser extent fat content. Milk obtained from PR cattle examined by Felenczak et al. [2005] was characterized by a high-fat content, total protein content, casein content and total solids content and good curdling ability and thermal stability what points on this milk good suitability for technological purposes. The short time of curdling is caused by high total protein content and especially casein. In table 1 is presented the average composition and technological properties of milk of PR cattle in BB κ-casein genotype [Felenczak et al. 2005].

Table 16.1. The average chemical composition and technological properties of PR cattle milk in BB κ-casein genotype (mean value ± standard deviation)

Traits	Mean ± SD
Total solids (%)	13.30 ± 0.83
Total protein (%)	3.38 ± 0.19
Casein (%)	2.67 ± 0.16
Fat (%)	4.26 ± 0.28
Lactose (%)	4.88 ± 0.30
Ca (mg/dl)	117.81 ± 12.05
P (mg/dl)	96.40 ± 7.35
K (mg/dl)	147.38 ± 11.75
Na (mg/dl)	59.07 ± 6.02
Density (g/cm^3)	1.0293 ± 0.015
Clotting (curdling) time (s)	289,8 ± 39,61
Thermal stability (min)	3,46 ± 0,36
Cheese yield (%)	28.07 ± 5.27

Source: Felenczak et al. [2005]

The outstanding quality of PR cattle breed is the result of both genetic predispositions of these animals and of the traditional way of feeding based on feds obtained from ecologically clean mountain areas with differentiated flora pelage. The milk of PR cattle breed beside the extensive, traditional way of breeding is characterized by a high total solids content, especially of protein and fat. The high level and favorable composition of protein fractions caused that milk was appreciated from ages as the outstanding raw material for cheeses production. The confirmation of above facts is a possibility of usage of PR cattle milk together with Polish Mountain Sheep milk for production of bryndza podhalańska (salty, molded rennet cheese), oscypek (salt, smoked rennet cheese, PDO) and redykołka (small, animal-shaped, salt, smoked rennet cheese, PDO) the traditional products with European Union granted quality sign of Protected Design of Origin (PDO). The milk of PR cows according to restraints put on by the PDO sign can be added during the production of oscypek and bryndza podhalańska cheeses in the amount of 40% to ewes milk when both animals are grazed with specific plants present in highlander meadows (in the Carpathian Mountains). Also, the PR cattle milk is registered in-state 'Traditional Products List' in Poland on 14th Dec 2012 (http://ec.europa.eu/agriculture/quality/door/document/1_pl; obtained 17th July 2019, https://www.gov.pl/web/rolnictwo/lista-produktow-tradycyjnych; obtained 17th July 2019). There is a promotion action developed to sustain the PR cattle through the exhibitions in Szczyrzyc (near Limanowa). Also, the Dairy Factory in Tymbark (Limanowa county) produces the pasteurized consumption milk originating from PR cows. The County Dairy Cooperative in Bochnia (Malopolska voivodeship) also selects milk of PR cows and started production of 'Polish Red Cow' consumption milk. In Bochnia Dairy also other ways of distribution of PR cows' milk are supported – the milk and sweet cream are sold to ice-cream shops for local, traditional ice-cream production.

16.3. Polish Mountain Sheep

In Poland, the sheep are mainly bred in the mountain areas and also in Wielkopolska and Podlasie voivodeships. The stock of sheep, in 2011, was at about 223 thousand animals. Ewes milk production is estimated at 1000 tons per year. The ewes are milked during the traditional summer grazing in the Podhale, Beskid, and Bieszczady Mountains regions [Danków and Pikul 2011b]. The basic Polish sheep breeds are Wielkopolska Sheep, Olkuska Sheep, Leszczyńska Sheep, Pomorska Sheep, Polish Merino Sheep, Świniarka Sheep, Wrzosówka Sheep and in the mountain areas mainly Polish Mountain Sheep – color and white varieties. The above-named sheep breeds can be specific indicators of the cultural heritage of mountain areas [Bonczar et al. 1998].

Polish Mountain Sheep originates from Zackel – the old primitive sheep breed with white and color variety, which was present in the southern Carpathian Mountains and

Balcans Mountains areas. Zackel had reached Polish territory with wandering along the Carpathian Mountains range Walachs-Ruthenian shepherds' tribes between the XIVth and XVIth centuries. Zackel is tightly combined with the culture and life habits of Carpathian Gorols. The milk, meat, and wool of Zackel were used for cheeses making – oscypek, bundz, and bryndza; for traditional meals preparing and as for wool and pelage for wearing and art hand-made pieces, respectively. The Zackel is a small sheep with building formed by generations of living in mountain areas. The sheep are small with a harmonious build body, rather thin but strong legs with flock pelage which protects it against though mountain climate. The rams have long coil-shaped horns and ewes are both with and without horns (smaller sizes). The Zackel gives thick, mixed wool of white, black, and sometimes reddish and greying hair. The Śląski Beskid Mountains and Podhale regions Zackel were the base of the creation of a noble Polish Mountain Sheep breed. The ennobling genetic activities bettered the bodyweight of adult ewes to about 50 kg; changed the character and yield of wool pelage; bettered milk yield – which nowadays when 150 days of grazing is applied – is at about 60 to 80 liters. It was managed, although yield parameters were changed, at large stocks, to protect Zackel precious assets of perfect adjustability to environmental conditions: good health, longevity, immunity, the delicious taste of young lamb's meat, and proper, as for breeding conditions, milking and fertility. The lamb meat stands from years the meaningful export commodity to the demanding Italian market. This phenotype adjustment to highlander mountains environmental conditions unquestionably prove the native characteristics of the genotype of this population – very precious and well adapted to our culture and landscape characteristics of our region (Małopolska).

The Polish Mountain Sheep grazed in Podhale region get the specific differentiated flora (the specific botanic composition of pastures and meadows) what influences on the taste and composition of milk and as a consequence gives to products obtained of this milk the outstanding aroma and taste (http://ec.europa.eu/agriculture/quality/_pl, accessed: 17th July 2019).

Polish Mountain Sheep the white variety is an inherent element of economy and culture created by highlanders. Not deniable is the advantageous influence of sheep on landscape formation and protection, especially in the such poor biotopes as the mountains themselves [Krupiński 2012].

Polish Mountain Sheep, the color variety is also the descendant of the old, primitive, numerous breed Zackel group, present from ages in the area of the Southern Carpathian Mountains and a part of Balcans Mountains. To the area of Polish Carpathian wandered parallelly with a white variety of Zackel. The color variety of Zackel was kept by Gorols because of color, dark wool, and skin used for regional clothes production or decorative elements. Both color varieties of Zackel became the inseparable part of culture and economy built by mountaineers. The advantageous influence of sheep on landscape and its preservation is undeniable, especially in such poor biotopes as mountain areas. The color variety of Mountain Sheep is covered with mixed, 2 fractions pelage of dark brownish color which is whitening and going red with animal's age. The typical is the presence of a white stain (star) or bold place on the animal's head and the white color of the end of the tail. The rams have horns and their weight is at about 50 kg, whereas ewes have horns or are hornless with adult animal weight at about 40 kg. Nowadays the number of this variety in the area of the Polish part of the Carpathian Mountains is estimated for at about 500–800 animals and is still diminishing. In the program of genetic resources protection of the sheep are included 5 herds with 154 ewes (obtained in 2005). This breed is kept in Malopolska voivodeship [Krupiński 2012]. Because of a small stock number, this breed can be perceived as 'dying – lost indicator' of cultural heritage.

The sheep is a perfect tool for the stimulation of rural development. The animals can be used multi-directionally and obtained from the raw materials can be an attractive good for the market and tourism. The shape and take care of landscape enlarging the space for recreation and tourism development. Their presence built new job positions, not only for shepherds. They allow for keeping and sustaining cultural heritage which is still based on the alive tradition of milk and other sheep origin raw materials processing. They are the indicator of the identity of the region, sometimes the way of living, especially for people who want to live in agreement with natural laws. Unfortunately, in Poland, more and more even can be seen grazing sheep herds, even in the mountains, which always were perceived as the bastion of sheep-breeding. Nowadays grazing sheep herds become a rarity – the sheep are vanishing from the Polish landscape. The diminishing of the sheep population is certified by the statistic numbers, which prove that in the recent two decades the stock of sheep has been drastically diminished. In Poland, in the last decade, in each year the amount of at about 10,000 sheep has vanished [Mroczkowski 2011].

16.4. The Carpathian goats breed

In Poland, keeping up and breeding of goats, after a few years of stagnation, developed in the 80ties of the XXth century. The interest in pro-health goat's milk properties caused the growth of demand for dairy goat's products. The main consumers became allergy sufferers, mainly children suffering from protein digestion defect and the elder people. Also, the public has started to appreciate the flavor values of goat's milk products, especially of cheeses. During the last fifteen years, goats breeding has been going through different stages of development. In 2007 there was observed the broke down of that breeding because of the decision of the Ministry of Agriculture and Rural Development to cease the support for goats' farmers, what was done by the Biological Development Fund financing the costs of milk yield, and fertility levels control. As a result of the above breeders have resigned from goats' utility assessment and control so they ceased the breeding work. The consequence of that was a drastic fall of stock included in milk yield control. In the following years, a further drop in controlled stocks was observed. Also with the diminishing of the amount of the number of animals bred 'in control', the regular stock number of goats felt down. From 2002, when the number of goats in Poland was 193 thousand, the slow drop of 39% of the goats' population took place at about 117 thousands of goats in 2010 [Sikora and Kawęcka 2015].

The largest amounts of goats are kept in the southern-east part of Poland. There are present small herds – from 1 to 3 animals. In 2002, in Malopolska voivodeship was kept 24 914 goats and it was 14.4% of the country stock of these animals and ranked Malopolska at the first place of several animals kept. In 2010 the stock diminished to 17 949 goats, which were mainly kept in Limanowski, Tarnowski, Myślenicki, Nowotarski, and Gorlicki counties. In the bred stocks of goats in Poland dominate the White Noble Goats (41%), the Color Noble Goats (19%). The lesser amounts were calculated for the White (without pedigree, 9%) and the Colour (without pedigree; 8%). The imported breeds of goats present in Poland are the Saanen Goats (18%) and the Alps Goats (5%). There are also present some small amounts of native goats breeds such as the Sanomierska Goat, the Casimir's Goat, and the Carpathian Goat. The Carpathian Goats (CG) can be also the indicator of the Carpathian Mountains' cultural heritage [Danków and Pikul 2011a, Sikora and Kawęcka 2015].

The impulse for enlargement of CG stock can be the attempt, of the Institute of Zootechnics State Research Institute, of the renovation of CG breed, which was a typical mountain pedigree. Nowadays in the Malopolska region are existing two herds of the Carpathian Goats [Sikora and Kawęcka 2015].

The goat milk is similar to cow's as the basic chemical composition but differs in the individual quality of fat and protein. The differences are in a different structure, composition, and dimensions of fat globules and casein micelles, also of other ratios of individual proteins fractions and of bigger amounts of non-protein nitrogen and mineral compounds (in goat's milk) [Wszołek 2001]. The comparison of basic goat's and cow's milk composition is presented in Table 16.2.

The goat milk is produced for direct consumption (raw culinary milk) or is processed for different dairy products such as liquid consumption milk (pasteurized and UHT), condensed milk and milk powder, rennet, and quark cheeses and fermented milk – yogurt, kefir, buttermilk, and sour cream. The acid curd of goat's milk is less cohesive and dense than that from ewe's or cow's milk so to obtain the desired texture of fermented milk produced from goat's milk some additional technological production procedures are demanded. But the direction of goat's milk processing for fermented milk is the most desirable because it allows combining the big nutritional value and high digestibility and assimilability, antioxidative properties and anti-allergic therapeutic values of goat's milk fermented products with the specific role of fermented milk in human nutrition [Domagała 2005, Danków and Pikul 2011a].

Table 16.2. Chemical composition of goat and cow milk

Component	Goat's milk	Cow's milk
Total solids (%)	11.50–13.20	12.30–13.50
Total protein (%)	2.90–3.76	3.20–3.50
Casein (%)	2.60–2.90	2.50–2.70
Whey protein (%)	0.30–0.86	0.70–0.80
Total fat (%)	3.07–5.10	3.40–4.20
Lactose (%)	4.10–4.50	4.60–4.70
Mineral compounds (%)	0.71–0.87	0,65–0.81
Cholesterol (mg/100 g)	11	14
Energy in 100g (kcal/kJ)	69/290	61/257

Source: Pandya and Ghodke [2007]

The production of goat's milk and its dairy products, in Poland, is a niche zone of the dairy products market. It is estimated that nowadays goat's milk production yield per year is at about 9.8 mln tons in the Malopolska region. The average milking yield of a goat is at about 542 kg per year. The small amount of goat's breeders distributes the goat's dairy products to the special (only with cheeses) or ecological shops to the big cities. Also, the production and trade at the place are observed in the agro-touristic farms. The very split production of goat's milk and dairy products cannot be noticed and influence on the global consumer market in Poland. The is a lack of well-advertised proposal of some goat's milk products with repeatable organoleptic characteristics that stops the development of this agro-market sector. There is also not present any goat's milk product at Traditional Products List of Malopolska voivodeship.

To conclude the breeding of goats in the Malopolska region, similarly as in the whole country stagnates. The factor which will favor this branch's economic success is to persuade the wider groups of consumers the other picture-new picture of goat's milk and meat with their flavor and dietetic values [Sikora and Kawęcka 2015].

16.5. Conclusion

Local, native animal breeds present at a certain area, and their usage for traditional food production can be the meaningful cultural heritage indicators, and parallel they can favor the economic development of the region. For the Malopolska region, there can be distinguished three main groups of farm animals bred formerly and nowadays as the cultural heritage of Walachs' traditional pasturing economy: the Polish Red Cattle, the Polish Mountain Sheep, and the Carpathian Goat. Nowadays only the PR cattle are included in the state genetic resources conservation program, whereas the Polish Mountain Sheep and the Carpathian Goat slowly, but steadily are vanishing from the Malopolska landscape. To conclude the breeding of traditional, native animals in the Malopolska region, similarly as in the whole country stagnates. The factor which will favor this branch economic success is to persuade the wider groups of consumers the other picture-new picture of native animals' milk and meat with their flavor and dietetic values.

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17

Polish Red Cattle and Polish Mountain Sheep and their products as the bio-indicators of Polish part of the Carpathian Mountains heritage

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Abstract. Polish Red (PR) cattle is the oldest and the only existing indigenous cattle breed in Poland. The herds of this dual-purpose breed are protected by the Genetic Resources Conservation Program. Polish Red cows are relatively small animals, with very good adaptability to tough environmental mountain conditions, fertility, and resistance against diseases. Milk yield is lower when compared to the high-yielding cows of the more popular breeds but is characterized by the high protein and fat content as well as biological and technological value. Polish Mountain Sheep (with a white or dark-brown coloured coat) is genetically well adapted to harsh mountain climate crossbreed of Podhale Zackel with Frisian rams and Zackel from Transylvania. This breed gives good milk yield with chemical composition particularly suitable for cheese production and high-quality lambs' meat. Lamb from Polish Mountain Sheep from the Podhale region, due to excellent organoleptic and physicochemical properties, such as soft, elastic structure, delicate, specific flavour similar to game, low-fat content, etc. has been awarded Protected Geographical Indication under the name 'Jagnięcina Podhalańska' since 2012. Milk from both Polish Red cows and Polish Mountain Sheep is the only permitted source milk for production of regional Bryndza Podhalańska, Oscypek, and Redykołka cheeses certified with European Protected Designation of Origin (PDO) indication. Traditional grazing with local breeds on the unpolluted mountain pastures rich in a variety of flora, including endemic plant species influences unique characteristics and high quality of the milk and meat products. It constitutes also material and intangible heritage of the Podhale region as pasturing together with the production of milk, cheese, wool, and leather has an old tradition dating back to at least 15th century. This tradition is also reflected in local architecture, regional products, art, dialect, costumes, ceremonies, and beliefs. Animals grazed on pastures not only constitute an integral part of the region's landscape but they also are an important factor that creates it.

Keywords: Polish Red cattle • Polish Mountain Sheep milk • meat • cheese

17.1. Introduction

Traditional food is produced using old methods, from traditional plant crops and/or autochthonous animal species, using only natural additives (e.g. spices) without artificial preservatives, stabilizers, flavoring, or coloring agents. The production is strongly connected with the region where it is performed, with its history and tradition. Thus it constitutes an important element of the material and intangible heritage [Alichanidis and Polychroniadou 2008].

Traditional dairy products are produced from native, local breeds of animals grazed on pastures and meadows located in the same area as all production processes. Their outstanding quality and sensory properties are highly appreciated by the aware consumers and there is observed a growing demand for such products. Therefore, certain certification schemes were established to protect their originality, such as European PDO (Protected Designation of Origin), PGI (Protected Geographical Indication), and TSG (Traditional Specialty Guaranteed). Among all these systems, PDO has the strongest connection with the region, as all steps involved in the production must take place in one, defined region. Poland can boast with three dairy products awarded with PDO certification and all of them are cheeses produced in the southern Carpathian region of the country, i.e.: *Bryndza Podhalańska, Oscypek*, and *Redykołka* [Kokotkiewicz et al. 2018]. On the national level the products which quality and unique characteristics and properties result from the application of the traditional production methods with at least 25-year old history, are a part of the cultural heritage of the region, where they are produced and are a part of the identity of local society are registered on the List of Traditional Products authorized by the Ministry of Agriculture and Rural Development [JL 2017, 1168]. There are many dairy products included in the list of traditional products, from which cheeses constitute a large group, including cheeses from the Carpathian region, such as three PDO types of cheeses as well as *gazdowski* cheese (*gołka, pucok, kara*), *bundz, gomółki kowalowskie*, *bryndza żywiecka*, *bryndza wołoska*, *wołoski* smoked cheese, *klagany* cheese, fresh white cheeses (tvarog), etc. Other dairy products from the south Poland region included in the List comprise cultured milk and cream from Limanowa, *żentyca* (a beverage made from ewe's whey), and other products. Regional products with the highest quality and produced for at least 50 years may be awarded the trademark 'Quality Tradition' (*Jakość Tradycja*) in the national system of food quality established by the Polish Chamber of Regional and Local Products [Polska Izba Produktu Regionalnego i Lokalnego 2020].

Milk processing in the Polish Carpathian region is strictly connected with an old shepherding tradition and with local breeds of animals, especially Polish Mountain Sheep and Polish Red cattle [Adamczyk et al. 2008]. The first written evidence of cheese production in Poland dates back to the XV century. The history begins from the Wallachians (Vlachs), semi-nomadic tribe, which migrated from the Balkan Penisula along with the Carpathian range and decided to settle down as far north as Polish Podhale. They brought sheep flocks and spread their pastoral culture and customs, with the specific pasturage organization called transhumance, traditional architecture (e.g. log hut called *bacówka*) and knowledge about the milk processing [Bonczar and Wszołek 2003, Kawęcka and Krupiński 2014, EC 2006a, EC 2006b, EC 2009b]. The knowledge, skills, and customs regarding the production of cheeses such as *bryndza podhalańska, oscypek*, and *redykołka* were passed down from generation to generation and have been continued to the present day almost unchanged.

According to EU regulations, regional cheeses certified with PDO (Protected Designation of Origin), such as *bryndza podhalańska, oscypek*, and *redykołka* have to be produced from ovine milk from Polish Mountain Sheep with a possible admixture of up to 40% of bovine milk but exclusively coming from Polish Red cows. Both breeds have a long history of rearing on the territory of Poland. Another restriction concerns the place of production, as all steps must take place in the specified geographical area (certain municipalities of the Lesser Poland and Silesian voivodeships). Besides the utilization of the local animal breeds, also feeding mode has a huge impact on the high quality of dairy products. During the vegetation period, i.e. from May to October, the animals are grazed on the clean mountain meadows and pastures rich in a wide range of plants, also medicinal, including the following species: snowcap (*Arabis alpina*), yellow thistle (*Cirsium erisithales*), arctic yellow violet (*Viola bilora*), alpine clematis (*Clematis alpina*), *Senecio subalpinus*, alpine snowbell (*Soldanella carpatica*), Austrian leopard's bane (*Doronicum austriacum*), wolfsbane (*Aconitum firmum*), saxifrage, alpine buttercup (*Ranunculus alpestris*), moss campion (*Silene acaulis*), cranberry (*Oxycoccos quadripetalus*), yellow saxifrage (*Saxifraga aizoides*), alpine blue sow thistle (*Cicerbita alpina*), net-leaved willow (*Salix reticu-*

lata), *Saxifraga wahlenbergii*, alpine poppy (*Papaver burseri*), golden cinquefoil (*Potentilla aurea*) and narcissus-flowered anemone (*Anemone narcissifolia*), etc. Out of the grazing season, animals are fed forages derived from the pastures and meadows of the specific region [EC 2007, EC 2009a, EC 2009b]. The conducted studies indicate that milk obtained from green grazed cows is characterized by better parameters for cheese manufacturing and contains higher amounts of compounds beneficial for human health, particularly whey proteins, polyunsaturated fatty acids, including CLA (conjugated linoleic acid) and fat-soluble vitamins [Barłowska et al. 2012]. The next factor influencing the unique characteristics and high quality of milk products of the Polish Carpathian region is the traditional production technology, without milk pasteurization, and utilization of original, often wooden, utensils, and vessels (e.g. *puciera, ferula, czerpak, oscypiarka*). The manufacturing of the PDO mountain cheeses takes place in log-huts and is associated with the exceptional skills of senior shepherds, who pass their knowledge from generation to generation, and thus the tradition has been continued from XV century to them nowadays. However, due to economic issues, i.e. not satisfactory income level for hard, demanding, handmade work, the production of dairy products from local animal breeds, especially with regard to sheep, is threatened [Kuźnicka et al. 2008].

17.2. Polish Red Cattle and its products

17.2.1. Characteristic of the breed

Polish Red (PR) cattle is the oldest existing autochthonic cattle breed in Poland, and one of the oldest cattle breeds in Europe, which originates from brachiceric small aurochs (bison) – *bos Taurus brachyceros* [Holm and Wójcik 2005]. The population of Polish Red cattle declined from 22% of the national bovine population in the 1950s to the current 1%. The herds of this dual-purpose (milk and meat) breed, thanks to the efforts made by Malopolska Society of Cattle Breeders, have been protected by the Genetic Resources Conservation Program since 1999. Currently, there are 259 herds (2419 heads) of dairy animals and 40 herds (577 heads) of animals for meat production included in the conservation program, kept mainly in the southern part of Poland (data for 2018). The goal of this program is the preservation and renovation of the PR breed, which contributes to the sustaining of the genetic biodiversity [Majewska 2019].

Polish Red cows are relatively small animals, uniformly pigmented from light red, through cherry red, to dark red, with properly formed, dark hooves and nostrils, pale horns with dark ends and strong legs (Fig. 17.1). The breed stands out for very good adaptability to difficult environmental mountain conditions, high fertility, easy calving, extraordinary longevity, and resistance against diseases (tuberculosis, mastitis, leukemia, etc.). The more popular, cow breeds such as the Holstein-Friesian (HF) having higher milk yield, are highly demanding as regards breeding and feeding, which cannot be fulfilled in the tough mountain and sub-mountain territories. Milk yield of PR cows is lower (on average 3,500–4,000 kg/year) when compared to the HF cows, but is characterized by the high protein and fat concentrations as well as high biological value and processing suitability [Gądek 1998, Adamczyk et al. 2009, Krupiński 2012].

Photo: D. Najgebauer-Lejko

Fig. 17.1. Cows of Polish Red breed in the mountain pasture

17.2.2. Milk from Polish Red cows

According to Litwińczuk and Szulc [2005] chemical composition of milk in 65% depends on the cow genotype and 35% is influenced by other factors, from which the feeding system is the most important. Furthermore, milk composition determines its nutritional and technological value. In Poland, there are nine breeds of dairy cows but dairy plants the most frequently utilize milk of Polish Holstein-Friesian (HF) breed for dairy production. The main reason is that HF cows give high milk yield.

Other breeds, such as Jersey, Simentaler, Polish Red, White-back, and Polish Black-and-White are usually of local importance.

Table 17.1. The average yield, chemical composition and technological properties of milk of Polish Red cows vs. Polish Black-and-White Holstein Friesian (fluctuations result from different lactation stages)

Specification	Polish Red	Polish Holstein-Friesian (Black-and-White)
Daily yield (kg)	9.60–17.31	24.02–32.70
Energy value (kJ/100 g)	315.77–344.93	306.54–324.97
Total solids (%)	13.24–14.06	13.08–13.57
Total protein (%)	3.21–4.05	3.17–3.58
Casein (%)	2.48–2.91	2.44–2.64
Fat (%)	4.38–4.78	4.14–4.45
SFA (% FAT)	67.58–68.83	74.21–74.37
MUFA	27.26–28.33	22.77–23.01
PUFA	3.58–4.13	2.48–2.59
CLA	0.56–0.96	0.24–0.30
Cholesterol (mg/100 mL)	16.04–20.28	21.97–24.25
Lactose [%]	4.70–4.81	4.73–4.82
Clotting time [s]	180.67–240.04	240.74–360.11
Thermal stability [s]	180.34–180.65	120.74–120.90

SFA – saturated fatty acids, MUFA – monounsaturated fatty acids, PUFA – polyunsaturated fatty acids, CLA – conjugated linoleic acid

Source: Litwińczuk et al. [2016]

When compared with milk derived from HF cows, milk originating from Polish Red cows is characterized by higher average total solids content, including proteins and fat concentrations (Table 17.1). From a nutritional point of view, this milk is characterized with more beneficial properties because of the higher proportion of unsaturated fatty acids (MUFA and PUFA), lower concentration of cholesterol and higher content of bioactive compounds present both in the protein: α-lactalbumin, β-lactoglobulin, lactoferrin, and lysozyme as well as in the lipid fraction: CLA [Felenczak et al. 2005, Adamczyk and Szarek 2009, Litwińczuk et al. 2012, Litwińczuk et al. 2016]. Moreover, higher protein content, particularly casein, the favorable proportion of protein to fat, and shorter rennet clotting time of milk from PR cows when compared to HF milk, make this raw material especially suitable for cheese production. On the contrary, PHF milk is a better material to produce UHT milk or milk concentrates were high heat stability is required (Table 17.1). The outstanding characteristics of milk of Polish Red cows were appreciated as it was assigned to the List of Traditional Products kept by the Polish Ministry of Agriculture and Rural Development on December 14, 2012 [MRiRW 2020].

It is worth to highlight that the exceptional quality and features of the milk derived from Polish Red cattle and products made from this milk result not only from the genetic predispositions (which is a key factor) of the animals but also from the feeding mode. Polish Red cattle are mainly reared in the south, mountainous parts of Poland, and grazed on the green pastures and meadows far from industrial sites or fed forages prepared individually by farmers out of the vegetation season. These traditional, extensive way of feeding differs greatly from the intensive system used in case of highly-productive HF cattle.

The pasteurized milk from Polish Red cows is in the offer of the local Limanowa-Tymbark Milk Factory. Milk derived from Polish Red is also a raw material for the production of many regional kinds of cheese (rennet and acidic), fermented milk and sour cream, and ice cream [MRiRW 2020, https://www.malopolska.pl 2020].

17.2.3. Fermented milks and cream

Besides milk from PR cows and cheeses, curdled milk is another traditional dairy product in Poland with a long history. The production is very easy, fresh milk should be left for several hours to let the mesophilic lactic acid bacteria present in milk to ferment lactose, produce lactic acid and firm coagulum. This is why it used to be produced at any individual farm and served as tasty and refreshing drink during peasant work in the fields or as a part of an everyday meal, often with warm potatoes with fried onion and bacon. The latter way of serving is still popular in Poland, especially during warm summer days. Curdled milk may also be mixed with fruits, e.g. strawberries. Taste is not the only advantage of this product as it is characterized by high nutritive value and some health-promoting properties resulting from the presence of calcium and vitamins (A, B, K) as well as a beneficial effect on the digestive tract. Produced from high-quality cow's milk, curdled milk from Limanowa has a thick consistency which can be cut out by a knife, is light yellow-creamy in color with a shallow layer of cream at the top, specific, clear and slightly acidic taste [MRiRW 2020].

Sour cream (*śmietana*) is a traditional Polish product obtained by lactic acid fermentation of cream, whose distinct quality results both from the traditional methods applied and the high quality of the raw material. Cows from which milk is derived are grazed on green pastures and meadows rich in herbs during the summer and fed with high-quality forages prepared individually by farmers in the winter. In the past, the cream was collected from the surface of raw milk which had become sour after a few days at room temperature as a result of the spontaneous growth of native lactic acid bacteria present in milk. Nowadays, the cream is obtained after milk centrifugation and subjected to further processing in local milk factories. Sour cream, characterized by dense and uniform consistency as well as clean, slightly acidic flavor, has been used usually as an additive for different meals, such as soups, dumplings, cakes, or for churning to obtain butter. Sour cream from Limanowa has been registered in the Polish Ministry for Agriculture and Rural Areas Development's List of Traditional Products from the Malopolska region since 2017 [MRiRW 2020].

17.2.4. Cheeses from bovine milk from Polish Red breed

17.2.4.1. Gazdowski cheese – gołka (kara, pucok)

Gazdowski cheese (from 'gazda' – mountain farmer in a highlander dialect), smoked scalded cow's cheese, is produced similarly as oscypek but is obtained from cow's milk (sometimes with the addition of ewe's milk) and in a different mass and shape: 300–600 g cylinder 6–15 cm long [MRiRW 2020]. The main advantages over the more famous oscypek, is that gołka can be produced throughout the whole year. Gazdowski cheese is softer in texture, has higher average moisture and salt contents but lower protein concentration than oscypek. Although both types cheese are produced using similar procedures, from unpasteurized milk, and in both types, sensory properties are formed mainly thanks to the action of the autochthonous microbiota from milk and the environment as well as a result of smoking and salting, oscypek cheese has a more pronounced, richer taste and aroma as well as firmer and more elastic texture [Kędzierska-Matysek et al. 2014].

According to Sip et al. [2010] lactic acid bacteria (LAB) of the *Enterococcus*, *Lactococcus*, *Lactobacillus*, and *Leuconostoc* genera are the prevailing microorganisms present in gazdowski cheese produced from a mixture of bovine and ovine milk (~10^9 CFU/g). Yeasts were also isolated in the significant amount from gołka, which may affect the specific characteristics of this cheese. Moreover, no pathogenic bacteria were present in the cheese and some studies even confirmed that some bacterial strains isolated from gołka and oscypek show strong bacteriostatic action against *Listeria monocytogenes* [Sip et al. 2012, Ołdak et al. 2017]. Gołka was included in the Ministry of Agriculture and Rural Development's List of Traditional Products in 2008 in the Malopolska and Silesian Voivodeships (where it is produced exclusively from the milk of Polish Red cows) [MRiRW 2020].

17.2.4.2. Fresh acid curd cheeses (tvarogs, white cheeses)

Tvarog (quark), in Poland, often named 'white cheese', is a fresh acid cheese produced from milk through the lactic fermentation by the bacteria present naturally in raw milk or added as a starter culture to the pasteurized milk. Traditionally all processes involved in the tvarog manufacturing were manual and it was usually produced from skimmed milk. In the present day, tvarogs are produced traditionally in local dairies from standardized in terms of fat content milk, which is pasteurized, cooled, inoculated with a mesophilic starter culture, and fermented for several hours. The curd is then warmed up to 30–40°C, cut, and pressed with subsequent drainage of whey. The 'white cheese' has an established position on the Polish market and is highly valued by the consumers due to centuries-long tradition, dietary habits, nutritional and dietetic value, and low prices. In Poland it is consumed without any preparation, often with jam or herbs and salt as an additive to baked goods or pasta, or as an ingredient of the traditional dishes, such as cheesecake, dumplings, etc. It can be produced and offered with different fat contents (skim, semi-skim, full-fat), fresh or processed (smoked, fried or steamed), plain, or with plant additives (herbs). Traditional tvarog has usually the shape of wedges or cubes [Ziarno and Lenart 2016, Król et al. 2018].

Fresh curd cheeses (tvarogs) registered as traditional in the Malopolska voivodeship are produced from raw milk derived from cows, including cows of Polish Red breed, grazed on the clean mountain, and sub-mountain meadows, located in the Limanowa, Wieliczka, and Bochnia districts. Out of vegetation, animals are fed diet prepared by farmers from hay, fodder roots, haylage, and concentrated fodders. The traditional way of feeding has a significant influence on the high nutritional value and sensory quality of tvarog [MRiRW 2020]. The required characteristics of these cheeses comprise uniform white to light cream color, firm, uniform, or slightly granular in the case of skimmed cheeses structure, clean, mild, slightly sour, and specific to this kind of cheese taste and odor. They are produced in different shapes and sizes, i.e.: wedges and cubes, blocks [MRiRW 2020].

Cottage cheese from Jasienica Rosielna is a skim or semi-skimmed white cheese (0.25–10 kg) produced from cow's milk derived from the cattle of the Polish Red and Simental breeds, grazed on the unpolluted Beszczady mountain and sub-mountain areas. This cheese was entered in the MARD's LTP in 2017 (Podkarpackie voivodeship).

17.2.4.3. Scalded cheeses other than oscypek and gołka

Not-certified scalded, smoked or un-smoked cheeses similar to oscypek and gołka, often labeled as mountain or regional cheeses are also produced in households, agritourism farms or industrially (usually by small local milk dairy plants) from cow's, or a blend of cow's and ewe's milk in different shapes, e.g.: strings, sticks, plaits, cylinders, rolls, oval shapes or balls [OSM Nowy Sącz 2020, SM Mlekovita 2020, Zakład Przetwórstwa Mleka 'Dominik' 2020]. Especially popular are *korbacze* (*korboce*) – semi-hard, slightly salty, smoked or un-smoked cheese strings twisted together or formed in a bunch produced usually from cow's milk. They are produced in the Polish Podhale and the Orava region in Slovakia (*korbáčik*) [Kruczek and Krauzowicz 2016, Kokotkiewicz et al. 2018].

17.2.5. Products obtained from PRC meat

The meat obtained from Polish Red Cattle is mostly used as culinary cuts. In Table 17.2 are presented some selected characteristics of that meat.

Table 17.2. Chemical composition of *lumborum* part of muscle *m. longissimus dorsi lumborum* (MLL) and semitendinosus muscle *m. semitendinosus* (MST) bulls of the Polish Red breed

Chemical component (%)	*Lumborum* **part of muscle** *m. longissimus dorsi lumborum* **(MLL)**	*Semitendinosus* **muscle** *m. semitendinosus* **(MST)**
Water	74.51±1.25	74.33±2.05
Total solids	25.49±1.28	25.67±2.08
Protein	21.97±2.85	22.11±1.98
Fat	2.30±0.31	2.31±0.18
Ash	1.11±0.05	1.15±0.1
Carbohydrates	0.11±0.01	0.10±0.018
Energy value [kJ/100g]	460.46	463.04
Thermal losses %	41.93±3.87	36.66±4.02
Colour		
L*	37.94±3.91	44.28±3.24
a*	11.15±1.57	7.41±1.36
b*	10.43±1.33	13.51±1.13
Texture profile of roasted meat		
Hardness (N)	119.2±11.21	114.6±12.14
Springiness	0.457±0.04	0.426±0.05
Cohesiveness	0.481±0.03	0.521±0.02
Chewiness (N)	26.18±2.11	36.44±3.41
Resilience	0.165±0.01	0.211±0.01
Shear force of roasted meat (N)	22.08±1.91	20.15±2.01

Source: Migdal et al. [2019]

In Table 17.3 there is presented composition of some example of PC meat products.

Table 17.3. The chemical composition the traditionally smoked cattle meat products

Sausages Hams	Chemical composition (%)						Energy value (kJ/100g)
	Dry matter	Protein	Lipids	Ash	Carbohydrates	Salt	
Beef ham G (Polish Red) Butchers 1	31.4	27.54	1.13	2.70	0.01	1.3	510.16
Beef ham M (Polish Red) Butchers 2	37.9	27.42	6.12	4.26	0.10	2.1	694.28
Beef kabanos (Polish Red)	63.82	39.73	18.77	3.81	1.51	2.1	1395.57
Serwolatka sausage (Polish Red)	33.06	19.51	9.26	3.40	0.89	1.7	689.42

Source: Migdał et al. [2020]

The nutritional value of PCR meat is comparable to other breeds of cattle characterized by the milk-meat utility. Consumers' choice of meat is mainly based on its color and marbling during the buying process, which is transferred into the specific texture and color properties of meat prepared for eating – culinary meat. According to Destefanos et al. [2008] mechanically measured shear force for so-called 'tender' beef meat cannot be higher than 42,9 N. Similarly, Shackelford et al. [1991] proposed the border value of shear force for beef meat as 45,1 N. In the opinion of Marino et al. [2011] the low tenderness obtained from local cattle breeds is one of the main factors influencing negatively meat quality. That phenomenon is combined with lower marbling of meat and bigger movement activity of animals grazed.

Litwińczuk et al. [2014] reported for young bull's meat of PC breed, aged for 2 and 7 days (post mortem), that color characteristics of meat had the biggest share of red color ($p < 0.01$) 24.8 and 27.1, and the lowest share of yellow color ($p < 0.01$) 0.9 and 2.6, respectively for both times of aging. The above characteristics were meaningfully different from the meat of all the rest cattle breeds. That phenomenon could be directly combined with the high pH of meat tissue and with the lower content of intramuscular fat (marbling) of PC breed [Mancini 2005]. According to Insanuti et al. [1999] and to Sierra et al. [2010] meat of rustic cattle breeds are characterized by a higher concentration of haem pigments and darker color in comparison to noble breeds (lower L^* and higher a^*).

The meat of native cattle breeds mostly demands longer aging time than that from cattle bred for meat utility [Marino 2011, Vieira 2006]. Properly chosen aging time allows for the elimination of differences in meat quality between breeds and between individual beings of the same breed and the end product is unified, well accepted by consumers [Campo 1999, Monson 2004].

17.3. Polish Mountain Sheep – milk and its products

17.3.1. Characteristic of mountain sheep (Podhale Zackel, Colored Mountain Sheep and Polish Mountain Sheep)

Three breeds of sheep can be found in the Polish mountain region, which are well adapted to the tough local environment i.e.: Polish Mountain Sheep (PMS), Colored Mountain Sheep (CMS), and the Podhale Zackel (PZ) [Kawęcka et al. 2020]. Zackel was introduced into the southern part of Poland by the Wallachian tribes between the 14th and 16th centuries. Polish Mountain Sheep is a crossbreed of primitive Podhale Zackel with Frisian rams and Transylvania Zankel. For a long time in the past, Podhale Zackel and Colored Mountain Sheep were classified as Polish Mountain Sheep (PMS), however, the original genetic makeup of Zackel was changed as a result of crossbreeding. Crossbreeding maintained an excellent phenotypic adjustment of the animals to the difficult and demanding mountain environmental conditions, resistance to diseases, longevity, while improving the body mass (approx. 50 kg for an adult ewe) and milk production with the average yield of 60–80 kg per 150 days of lactation. Sheep in the Polish mountains have been kept not only for milk but also for wool and leather and meat. Lamb from Polish Mountain Sheep, famous for its taste, specific flavour, soft, elastic structure has been awarded PGI (Protected Geographical Indication) certificate. Moreover, the traditional way of feeding on rich in herbs mountain meadows and pastures contributes to the high quality and unique characteristics of the milk and meat products derived from PMS [EC 2009b, Danków and Pikul 2011, Krupiński 2012].

Moreover, sheep grazed on the mountain pastures and meadows not only constitute an integral part of the landscape but grazing sheep itself is also an important factor that creates and shapes this landscape. Unfortunately, recently a dramatic reduction in the heads of sheep stock has been observed caused by the intensification of production. Polish Mountain Sheep have been included in the Genetic Resources Conservation Program since 2007 and 2000 (respectively for Podhale Zackel and Colored Mountain Sheep) [Mroczkowski 2011, Kawęcka and Sosin-Bzducha 2014].

17.3.2. Ewe's milk from mountain breeds

Polish Carpathian region is virtually the only place in Poland where ewe's milk is utilized for dairy production [Kawęcka et al. 2020]. Ewe's milk, when compared to milk obtained from most of the other dairy animals, e.g. cows or goats is more nutritious as it is more caloric and contains higher amounts of total solids, proteins, fat, minerals and water-soluble vitamins (Tables 17.1 and 17.2]. The fat of the ewe's milk is also richer in bioactive dienes of conjugated linoleic acid (CLA) and free fatty acids. Due to relatively high amounts of carotene and riboflavin ewe's milk stands out with creamy-light yellow color. Ovine milk is also characterized with higher bacteriostatic activity than bovine milk, what affects longer time needed to initiate spontaneous milk fermentation but also higher microbiological stability during storage [Bonczar 2001, Danków and Pikul 2011, Kawęcka et al. 2020].

The dense composition of ewe's milk, especially high protein and casein content, make it an excellent raw material for the production of fermented types of milk and cheese. In the former case, yogurts and other fermented kinds of milk can be produced with the desired body and texture and lack of syneresis without and thickening agents or additional technological operations. However, most of the ewe's milk in Poland is destined for cheese production, especially for *oscypek* manufacture (approx. 70% of total ewe's milk). Utilization of ewe's milk results in almost two times higher cheese yield when compared to cow's milk. However, one should bear in mind that sheep provide about 60-70 liters of milk per lactation (much lower than cow), lactation lasts for a few months (about 150 days) and animals are milked by hand [Danków and Pikul 2011, Kawęcka 2020].

Table 17.4. The average basic composition and density of sheep milk and milk of Polish Mountain Sheep

Specification	Sheep milk	Milk of Polish Mountain Sheep
Total solids (%)	18.45±3.05	19.87±3.00
Solids non-fat (%)	11.40±1.10	11.63±1.28
Protein (%)	5.85±0.95	6.70±1.18
Fat (%)	7.05±1.95	8.58±2.21
Lactose (%)	4.80±0.60	4.21±0.76
Minerals (%)	0.89±0.07	0.955±0.005
Density (g/cm^3)	1.0335±0.005	1.0346±0.0045

Source: Bonczar [2001], Kawęcka and Pasternak [2019], Kawęcka et al. [2020]

Kawęcka et al. [2020] while studying the quality of milk from three mountain breeds of sheep i.e.: Polish Mountain Sheep (PMS), Colored Mountain Sheep (CMS), and the Podhale Zackel (PZ) found that there were no significant differences between them as regards basic composition and properties, except for urea which may be indicative for slightly different nitrogen metabolism or different preferences of the animals as regards eaten plant species [Kawęcka et al. 2020]. However, higher content of nutrients is specific for milk obtained from mountain sheep when compared to other breeds [Table 17.4, Kawęcka and Pasternak 2019].

Many world-famous and excellent cheeses are produced from ewe's milk, including Italian Pecorino, Greek Feta, and French Roquefort and Spain Manchego. In Poland, the most famous ewe's cheeses are *bryndza*, *oscypek*, and *redykołka* [Górska 2014].

17.3.3. Cheeses and whey products from ovine or mixture of ovine and bovine milk

17.3.3.1. Bryndza

Bryndza Podhalańska was the first Polish cheese awarded PDO indication in 2007 [EC 2007] and according to Agricultural and Food Quality Inspection (AFQI), official inspection body for agricultural and food products labeled with registered PDO or PGI, there are eight registered producers of this cheese [IJHARS 2020]. It is a spreadable, soft (up to 60% of moisture), rennet cheese, containing at least 38% of fat in dry mass, characterized with strong, salty, and slightly sour taste, white, creamy-white or with a willow green shade color. It is produced in the entire Nowotarski and Tatrzański districts, in the municipalities in the Sucha district: Zawoja, Bystra Sidzina and in the municipalities of the Żywiecki district: Milówka, Węgierska Górka, Rajcza, Ujsoły, Jeleśnia, and Koszarawa. The production procedure of the *Bryndza podhalańska* [EC 2006a] includes the following steps: addition of the rennet (*klaganie*, 1.1–2.7 g of powdered rennet per 100 L of milk), curding at the temperature of 28–39°C for 30–60 min), breaking up the curd (cutting with a wooden tool called *ferula*), settlement of the curd, decanting of the whey (30–50%), dripping (hanging out in a special cloth, for at least 12 hrs), seasoning and fermentation (4–12 days), breaking up the cheese into small chunks, mixing with salt. The manufacturing methods, e.g. the way of breaking up the cheese, etc., may differ among different producers based on the individual technology developed by each of the senior shepherds. Bryndza may be also preserved by pouring melted butter on the top of the final product [EC 2006a, Regionalny Związek Hodowców Owiec i Kóz 2006].

Other kinds of *bryndza* produced from ewe's milk but not certified with PDO are *bryndza żywiecka* and smoked *bryndza wołoska*. Both products, which have a long tradition in the Podhale region and are produced using old shepherding methods, have been registered as the traditional products by the MARD in Poland. *Bryndza żywiecka* is produced in the form of white, salty balls with sharp taste and aroma. Smoked *bryndza wołoska* is offered in the form of balls or slices, with soft but firm consistency, piquant taste, and distinct aroma of smoke [Migdał et al. 2019, MRiRW 2020].

The sensory quality of *bryndza* is affected by many factors, such as an amount of salt added and quality of raw material is the most important when traditional methods are applied (without milk pasteurization and addition of starter cultures). The saltiness of *bryndza* depends on the taste and preference of the senior shepherd, while other specific to *bryndza* taste and aroma components are formed as a result of the microbial action and are influenced by the type and number of microbiota present in milk and production environment and their growth during cheese production and ripening. The main microbial species present in *bryndza* comprise lactic acid bacteria from the geera: *Lactococcus* ssp., *Lactobacillus* ssp., *Streptococcus* ssp., *Enterococcus* ssp. and fungi, including *Kluyveromyces marxianus*, *Galactomyces candidus/Geotrichum candidum*, *Yarrowia lipolytica*. It is believed that the best *bryndza* with the highest quality is produced in May, at the beginning of the grazing period which is probably connected with the flora composition of the spring pastures [EC 2006a, Regionalny Związek Hodowców Owiec i Kóz 2006, Pangallo et al. 2014].

Soft, salty, and moderately pungent bryndza cheese can be consumed alone or as an additive for meals of the traditional highlander-style cuisine, e.g., dumplings or bryndza noodles (*haluszki*) [https://bacowkatowary.pl 2020].

Soft, unripened cheese under the name of 'bryndza' is also produced on an industrial scale by dairies located in the south part of Poland. The main difference is that bryndza produced in factories is produced from cow's milk with only a small addition of ewe's milk (*Bryndza sądecka*) or solely from cow's milk (*Bryndza podhalańska*) subjected to pasteurization and with the subsequent addition of starter bacterial culture and thickening agents [OSM Nowy Sącz 2020, SM Mlekovita 2020].

17.3.3.2. Bundz (bunc) cheese

Cheese mass, during *bryndza* production, after dripping in a cloth and before breaking up into pieces, takes the form of a loaf, and in the highlander dialect is called *bunc*, *bundz*, *udój*, or *gruda* (*grudka*). Bunc is a soft, rennet, lump cheese obtained from raw ewe's milk, offered fresh (sweet variety), or after ripening for free days when lactic acid fermentation proceeds (slightly acidic variety). It can be also smoked. This cheese has a thin, white-cream and flexible rind, smooth consistency with rare, small eyes and is white with a possible willow-green tint inside. Basic nutritional value of this cheese results from the 45–46% concentration of total solids, 16–18% protein, 22–29% fat, 0.1–0.3% carbohydrate, and 1.5–1.7% ash contents. Amount of 2.5 L of ewe's milk yields about 2.5 kg of bunc [Bonczar and Wszołek 2003, Danków and

Pikul 2011, Kawęcka and Pasternak 2019]. The sensory properties of this cheese are not constant throughout the year and the best bundz, often referred to as 'may bundz' is produced in the spring [Kawęcka and Pasternak 2019].

Whey remaining after the bundz production is utilized during the cheese processing, for production of whey beverage (*żentyca*) or to feed animals.

Bunc has been present in the MARD's List of Traditional Products since 2005 (Malopolska) and 2007 (Silesian Voivodeship).

17.3.3.3. Oscypek

Oscypek (*oszczypek*) is a hard scalded and smoked, double cone, or spindle-shaped cheese produced from May to September from exclusively ewe's milk or a mixture of ewe's and cow's milk. It is characterized by a straw-colored to light brown, shiny rind and light cream color inside. The weight should be 600 to 800 g, the length: 17–23 cm and diameter of 6–10 cm. The name *Oscypek* comes from the word *oszczypywać* – which means to pinch rapidly, like during one of the production stages, or *oszczep*, meaning 'javelin', in reference to the shape of this cheese, or from the word *oscypiarka* – the curved wooden molding form used to give the final product characteristic patterns. The *oscypek* cheese has become the most famous Polish cheese and the symbol of the Tatra Mountains. Its name, characteristics, and methods of production have been protected with the UE PDO certificate since 2008 [EC 2008, Fonte 2008, Adamski and Gorlach 2016]. According to EU requirements, this cheese can be produced exclusively in the shepherds' huts, by the registered producers from the selected municipalities from the Lesser Poland (Malopolska) and Silesian voivodeships. Furthermore, the manufacturing of the *oscypek* is restricted to the traditional hand-processing procedures and to strictly defined ingredients allowed. It is produced from ewe's milk derived from sheep (Polish Mountain Sheep breed) pastured on high mountain meadows (called *hale*) or from a blend of ovine and bovine milk, provided that the last comes from the native Polish Red cows and its proportion to ewe's milk does not exceed 40%. Thus, the PDO label guarantees the authenticity of the *oscypek* and its high quality associated with the strictly defined geographical area where all steps of the production take place, raw materials, and traditional methods applied. This is very important for consumers as it gives an assurance that the offered product is not, in fact, the *oscypek*-like cheese produced from cheaper and more easily available ingredients and/or using industrialized technology [Majcher et al. 2015].

Production of the *oscypek* comprises the following steps: cold and warm maturation (fermentation) of raw milk, coagulation with rennet, beating of the coagulum, settling of the cheese curd, removal of whey, combination of pressing, grinding and scalding in hot water or whey, shaping (also using a curved wooden form called *oscypiarka*), smoothing, brining, drying and smoking in cold smoke for 3–7 days [EC 2006b, Majcher et al. 2010].

The chemical composition of the *oscypek* cheese results mainly from the composition of sheep milk or also cow's milk if the mixed *oscypek* type is produced. According to UE standard, oscypek should be characterized by water content not higher than 44% and fat content no lower than 38% [EC 2006b]. The study performed by Kokotkiewicz et al. [2018] revealed that the basic composition of the oscypek produced from a mixture of ewe's and cow's milk did not diverge from the composition of the respective cheese produced exclusively from ewe's milk (Table 17.5).

Table 17.5. Average energy value (kcal/100 g) and concentrations of basic chemical constituents and calcium (g/100 g) in the *oscypek* cheese

Item	Type of the *oscypek*	
	Ovine	Mixed ovine-bovine
Energy value	371	371
Total solids	66.0	66.1
Protein	29.6	29.7
Fat	27.1	27.0
Carbohydrates	2.7	2.9
Ash	6.6	6.5
Calcium	0.866	0.918

Source: Kokotkiewicz et al. [2018]

Ewe's cheeses, e.g. *oscypek* when compared to cow's cheeses (*gołka*) are characterized by the higher content of short-chain and medium-chain FA (C4:0–C12:0), particularly capric acid, and a lower percentage of palmitic (C16:0), stearic (C18:0) and palmitoleic (C16:1) acids [Kudełka 2014].

There are many factors influencing specific, slightly sour, piquant, salty and smoked aroma of the *oscypek*, such as animal breed and feeding mode (fresh, unpolluted pastures rich in medicinal and often endemic vegetation), specific microflora native to milk, traditional hand-made processing performed in huts with the use of traditional, usually wooden tools and vessels (*puciera*, *ferula*, *czerpak*), and natural preservation methods including salting in brine and slow smoking in cold smoke [Majcher and Jeleń 2011]. Chemical analysis revealed that 11 substances contribute to the greatest manner in the overall aroma of the *oscypek* cheese, described as smoked, pungent, butyric and buttery, toasted, milky, rennet, and brine. These compounds include phenolic compounds formed during wood smoking as a result of thermal degradation and depolymerization/oxidation of lignin (guaiacol, 4-methylphenol, 2-methoxy-4-methylphenol, 3-ethylphenol, 2,6-dimethylphenol, 2,4-dimethylphenol), as well as compounds formed from lipids, amino acids and carbohydrates through biochemical reactions during cheese production and ripening, such as ketones (diacetyl), carboxylic acids (3-methylbutanoic acid), aldehydes (3-(methylthio)propanal), fatty acids (acetic and butanoic acids). Among these, guaiacol (2-methoxyphenol) was identified as the most important odorant [Majcher et al. 2011, Majcher and Jeleń 2011]. Flavoring compounds in *oscypek* cheese are generated mainly during the smoking stage of the production (phenolic compounds, aldehydes, alcohols, furans/furanone) and to a lesser extent as a result of the activity of the bacteria (methyl esters, ketones, aldehydes, alcohols, sulfur compounds) or indigenous milk enzymes and rennet activity (e.g. free fatty acids) during curding, scalding and brining, and only small amounts come from raw milk (e.g. terpenes, methyl esters, alcohols) [Majcher et al. 2011]. Moreover, the solid-phase microextraction-mass spectrometry method (SPME-MS) combined with chemometric detectors revealed that the volatile characteristics of the original *oscypek* differ greatly from that of the *oscypek*-like cheeses produced from cow's milk and/or cheeses produced using industrial methods [Majcher et al. 2015]. *Oscypek* when compared to its imitations, especially those made by industrial methods from pasteurized milk, is characterized by a richer flavor bouquet composed of a larger number of volatile compounds [Majcher et al. 2010].

The most abundant microbiota found in ovine milk is mesophilic bacteria, mainly belonging to the *Lactococcus*, *Lactobacillus*, *Leuconostoc*, *Streptococcus* and *Enterococcus* genera, present at the average level of 10^2–10^6 CFU in 1 mL of milk. These bacteria are very important as they are responsible for lactic acid fermentation during the production of traditional cheeses (e.g. *oscypek*) and fermented milk or cream from unpasteurized milk. Ewe's milk can be also contaminated with fungi (yeast and molds) and psychrotrophic bacteria, or occasionally with other microorganisms such as *Staphylococcus aureus*, *Salmonella* spp., *Escherichia coli*, *Clostridium perfringens*, *Bacillus cereus*, *Listeria* spp., *Helicobacter pylori*, pathogenic streptococci, etc. [Alexandraki et al. 2016]. During the manufacturing of the o*scypek*, as no starter culture is applied, all microorganisms come from milk and to a lesser extent from the used wooden utensils, vessels, and from the environment where the cheeses are produced i.g. shepherd's hut (yeasts). For these reasons, microbiological quality, and as a result of sensory and other properties, of the cheeses obtained from different producers and even from different batches may vary significantly. The most abundant microbiota found in *oscypek* belonging to the genera *Streptococcus*, *Lactobacillus*, *Lactococcus*, *Leuconostoc*, and *Enterococcus*, have favorable conditions for growth in milk being processed but only until the scalding of the curd. The subsequent scalding, brining and smoking have a negative impact on the viability of microorganisms because of the high temperatures applied (scalding 50–70°C), low water activity (brining) as well as bacteriostatic or bactericidal activity of phenolic compounds formed during cold or warm smoking [Majcher et al. 2011, Alegría et al. 2012]. The study of Wszołek and Bonczar [2003] revealed that the total count of microorganisms in the freshly smoked *oscypek* cheese was in the range of 8–9 log CFU/g with the prevalence of the inherent lactic acid bacteria (LAB). Cheeses directly after production contained also coliforms (10–10,000 CFU/g), yeasts and in some samples, molds were also detected. The number of microbiota in the cheese samples after smoking was lower than the respective count before this process. During subsequent storage further, the decrease in the microorganism count was noticed, some of them like coliforms even diminished after 60 days. The presence of pathogenic bacteria and fungi in the *oscypek* cheese is highly influenced by the hygienic standards during production, which constitutes a big challenge all over the world when the cheese is produced from raw, unpasteurized milk. The presence of the microorganisms from the *Enterobacteriaceae* family is known to be an indicator of the deficiencies in production hygiene. During microbiological studies, the coliforms, *Escherichia coli*, yeasts, molds and small numbers of *Clostridium perfringens* spores, as well as *Staphylococcus aureus* (but without accompanying staphylococci toxins), were detected in some samples of the oscypek by Berthold-Pluta et al. [2011] and Wszołek and Bonczar [2003]. On the contrary, oscypek samples assessed Surówka et al. [2016] did not contain *Listeria* and *Salmonella* cells. These facts emphasize a key role of the high hygienic standards during each of the production stages in the maintaining of the high quality and safety of the oscypek cheeses.

It is worth to highlight, that regional smoked cheeses are characterized with high quality and safety, in terms of the content of polycyclic aromatic hydrocarbons (PAHs) fulfilling the demands of EU regulation (1327/2014). There is a high risk of PAHs production and accumulation in foodstuffs, especially rich in fat, during traditional smoking. However, as long as smoking of cheese is performed in cold or warm smoke, there is no threat of the formation of excessive amounts of PAHs [Migdał et al. 2018].

17.3.3.4. *Redykołka*

The name *redykołka* is given to the small (up to 0.3 kg) scalded cheeses formed like birds, other animals, spindles, or hearts. The word *redyk*, from which the name *redykołka* comes from, in the tradition of Podhale means the ceremonial return of the sheep flocks (*kierdle*) from the mountain pastures in September (Autumn *redyk*) [EC 2009b]. The production procedure of this semi-hard, half-fat cheese, is similar to the *oscypek* cheese. *Redykołka* has been awarded the PDO indication since 2009, but at this time only three producers from Jurgów, Ochotnica Górna, and Koniaków are registered [EC 2009a, IJHARS 2020].

17.3.3.5. *Klagan*y cheese (ser klagany)

Klagany cheese, in the past was produced solely from the ewe's milk, nowadays it may also be produced from cow's milk. This cheese is produced in the Cieszyn Silesia region by the highlanders. It is a white and soft (fresh cheese) or creamy and harder (ripened cheese) cheese, with the following characteristics: thin white or creamy/

yellow rind, shape – depending on the used form, usually loaf-formed, size – up to 20 × 15 cm, creamy taste, after ripening taste and aroma may be acidic. Klagany cheese was registered in the MARD's LTP in 2006 [Furczoń et al. 2007, MRiRW 2020].

17.3.3.6. Wołoski smoked cheese

Wołoski smoked cheese is another example of smoked ewe's cheese produced with the use of traditional methods (based on intergenerational transmission) in the form of round cake with the rosette motive on the top. It has been registered in the Ministry of Agriculture and Rural Development's List of Traditional Products in the Silesian Voivodeship since 2006 [Furczoń et al. 2007, MRiRW 2020].

17.3.3.7. Żentyca

Żętyca (or *żentyca)* is a kind of nutritious beverage obtained from ewe's whey removed during *bundz* production (also as a stage of the *oscypek* production). Obtained after milk rennet coagulation whey is heated slowly in a copper kettle over a bonfire but only to the first symptoms of cooking. Heating of the casein-free solution to the temperature near 90°C results in the coagulation of whey proteins, which form a soft coagulum floating on the surface of the liquid. The obtained liquid with some amount of coagulated whey proteins is called *żentyca*, which can be served warm and fresh or it can be left for a few or several days to let the lactic acid bacteria present on wooden vessels and equipment in the log hut to produce a more sour version.

This product was listed in the Traditional Products List of the Ministry of Agriculture and Rural Development on September 28th, 2005. Żentyca is a white or light creamy beverage, sweet (fresh variety) or slightly acidic (fermented variety) with a moisture content ranging from 60 to 70%, salt concentration up to 0.5%, fat content 3–4% (ewe's *żentyca*) and 2–3% (*żentyca* from mixed cow's and ewe's milk) [Furczoń et al. 2007, MRiRW 2020].

Żentyca is often consumed as a main meal by shepherds, or together with potatoes, dumplings or bread. Tasting *żentyca* is also an attraction for tourists, who are offered *żentyca* in decorative, wooden scoop pots. It was also served to bathers with therapeutic mineral waters in Szczawnica spa facilities. According to shepherds, *żentyca* is a good remedy to cure dysfunctions of the gastrointestinal and upper respiratory tracts and even for Alzheimer disease [Bonczar 2006, Drożdż 2007, Kuźnicka and Zajączkowska 2009].

17.3.3.8. Hurda (urda, wurda)

Hurda is a kind of ricotta-type cheese rich in nutritious whey proteins (also albumin). It is obtained from ewe's whey heated to 90°C. Curd consisting of whey proteins is collected from the surface of a heated liquid (by a ladle) and drained [Furczoń et al. 2007].

17.3.4. Meat products obtained from Polish Mountain Sheep

17.3.4.1. Culinary meat of Podhale Zackel (*Jagnięcina Podhalańska*)

Lamb from Polish Mountain Sheep from the Podhale region, due to excellent organoleptic and physicochemical properties, such as soft, elastic structure, delicate, specific flavour similar to game, low-fat content, etc. has been awarded Protected Geographical Indication under the name *Jagnięcina Podhalańska* since 2012.

Jagnięcina podhalańska meat is lamb meat obtained from animals of Polish Mountain Sheep and Podhale Zackel, slaughtered up to 60 days of life. The carcasses obtain 4 to 8 kg. Lambs are fed solely with the mother (ewe's) milk. In summer and autumn, the sheep- mothers are grazed in mountain pastures, green fodder forming the basis of their diet. In winter and early spring, the sheep are fed hay, hay silage, and concentrated feed. Except for concentrated feed, other feed must come from the geographical area defined – Silesia province: Cieszyn district, Istebna municipality; Żywiec district: Milówka, Węgierska Górka, Rajcza, Ujsoły, Jeleśnia, and Koszarawa municipalities. In Lesser Poland province: the whole of Nowotarski district and the whole of Tatrzański district; Sucha district: Zawoja, Bystra and Sidzina municipalities; in Limanowa district: Niedźwiedź and the part of Kamienica which is situated within the Gorce National Park or south of the River Kamienica, and the following civil parishes in Mszana Dolna municipality: Olszówka, Raba Niżna, Łostówka, Łętowe, and Lubomierz; Nowy Sącz district: Piwniczna, Muszyna, and Krynica municipalities. The area defined forms part of the Western Carpathians, which includes the Tatras, Beskids, Pieniny, and Gorce. The unique method by which sheep are reared in this area was developed over centuries and forms an integral part of the region's landscape and culture [EN13.1.2012 Official Journal of the European Union C 11/17]. The largest herds are grazed in the Podhale region. The Podhale area is home to a wealth of unique vegetation, including both native and imported plant species. Podhale is the only part of Poland in which the following plants can be found: *Delphinium oxysepalum*, *Linum extraaxillare*, *Gentiana nivalis*, *Gentiana clusii*, *Saussurea alpina*, *Saxifraga hieracifolia*, *Viola alpina*, *Campanula alpina*, *Anthyllis alpestris*, *Hieracium villosum* and *Astragalus penduliflorus*. The lamb meat is characterized by a low-fat level in the carcass and outstanding juiciness. The color of that meat is light red – pinky with soft and tender structure. The most characteristic indicator of *Jagnięcina podhalańska* meat is its specific taste and odor, close to game meats i.e. venison [EC No 510/2006'Jagnięcina Podhalańska' 2010].

To preserve these outstanding features of lamb meat as culinary usage and raw material for some products, there are attempts to keep sheep of above-described breeds with two ways feeding system – the first traditional one and the second regulated with special feeding system to obtain the methods of keeping of quality of meat and the profitability of breeding, because the natural way of pasturing is vanishing. The sheep are kept longer than 60 days and the feeding systems undergo some amendments. The breed of Podhale Zackel (PZ) is chosen for the experiment. 1st feeding system is: the PZ lambs assigned for slaughter, after weaning on the 100th day, are grazed on pastures and fed small amounts of bran (GZ – grazing, maternity farms). 2nd feeding system is: the PZ lambs assigned for slaughter, after weaning on the 100th day, are fed a mixture containing 15% rapeseed cake, 15% dried corn stool and 5% flaxseed in the amount of 3% of lamb body weight and grass hay, which they received without restrictions (a method used in Institute of Zootechnics State Research Institute Kołuda Wielka, KW). The PZ lambs were fattened to obtain an average weight of 35–40 kg.

After reaching the appropriate weight, the lambs were slaughtered and transported to the laboratory of Animal Products Processing Dept., University of Agriculture. All the analyses were conducted on the *longissimus dorsi lumborum* muscle and are presented in Table 17.6.

Table 17.6. The chemical composition of lamb meat depending on the breed and type of feeding system

Lamb's breed	**Feeding system**	**Dry mass (%)**	**Protein (%)**	**Fat (%)**	**Ash (%)**	**Carbohydrates (%)**	**Energy value (kJ/100g)**
Podhale Zackel (PZ)	KW	20.65±0.33	16.36±3.46	2.22±0.25	1.10±0.07	0.97±0.06	376.75
	GZ	19.61±0.15	15.98±0.71	1.76±0.24	1.16±0.06	0.71±0.05	295.80

Mean values ± standard deviation values
GZ – fattening methods used in maternity farms
KW – fattening methods used in Kołuda Wielka

Source: Zając et al. [2019]

The level of fat in lamb meat depends both on the feeding method and the breed and it is possible to modify those factors. According to Grześkowiak [2003], the optimal amount of intramuscular fat in muscle tissue should be in the range of 1,5–2,5% to obtain the best sensory quality. The results in that range were obtained by Borys and Borys [2002] in lamb meet of various breeds. However, in the presented studies the amount of fat in most of the breeds was higher. According to Kędzior [2005] the changes of chemical components' proportions which are observed during the growing period and the body mass increase, are associated mainly with the subcutaneous fat increase. It is especially noticeable in bigger animals in which the muscle mass content decreases at the same time.

Gruszecki et al. [2001] noted that lambs fed in alcoves are growing faster and that they obtain the bodyweight of 30 kg 20 days earlier compared to the animals fed on pastures. Moreover, they have better body conformation, but higher subcutaneous fat content. Pasture feeding resulted in higher muscle content and lower fat content compared with the meat of animals fed the concentrated feed [Ripoll et al. 2010]. It can be concluded that intensive breeding causes relatively fast fat accumulation while at slower feeding intensity the muscling is higher at the same body weight.

There were also produced sausages – obtained solely from lamb meat and fat (in our laboratory), fed with two described above feeding systems. Their composition and energy value were compared to a similar product obtained from the market. The market product was produced by 'Butchers Bielsko Biała' (BB). Table 17.7 contains comparable data for both products.

Table 17.7. Chemical composition of sausages obtained from native lamb's meat depending on feeding system and place of production

Lamb's breed	Feeding system	Dry mass (%)	Protein (%)	Fat (%)	Ash (%)	Carbohydrates (%)	Energy value (kJ/100g)
Podhale Zackel (PZ)	KW	35.23±0.35	20.51±3.63	10.69±0.33	3.16±0.03	0.87±0.08	758.99
	GZ	34.35±0.20	20.34±1.92	8.97±0.49	4.09±0.01	0.95±0.09	693.82
Polish Mountain Sheep (BB)	GZ	43.81±0.75	25.17±1.12	14.81±0.65	3.59±0.02	0.23±0.07	979.77

Source: Migdał et al. [2019], Migdał et al. [2020]

Podhale Zackel sheep is the old type, primitive breed, and the carcass parameters allow for the production of meat products with so-called pro-health characteristics – low fat, high exogenous protein level, and outstanding quality characteristics – juiciness and color [Migdał et al. 2019]. Whereas products – sausages obtained from the market shown a higher level of fat, and also of protein, but the detailed composition of that protein is still under research so there cannot be concluded that BB sausages were better. There was declared anything but the breed – Polish Mountain Sheep concerning the market product raw material characteristics. It can be perceived that the meat used originated rather from heavy lambs (aged at about 10 months). This type of raw material has already the typical 'sheep' like odor which is not recognized well by most of the contemporary consumers, although the BB product was acceptable probably because of the traditional smoking technique used for its preparation [Migdał et al. 2020].

17.4. Conclusion

National autochthonic animal breeds are well adapted to local, traditional (extensive) conditions of feeding and treatment and provide raw materials particularly suitable for the production of traditional foodstuffs. Poland has one of the richest genetic resources in Europe. Mountain sheep, including Podhale Zackel and Colored Mountain Sheep, as well as Polish Red cattle are the animals perfectly adjusted to difficult pedoclimatic conditions of the Polish Carpathian region, resistant to diseases, which from ages constitute an integral part of the local landscape and are closely related with the regional culture, customs and even architecture (e.g. log huts). Food products obtained from them have unique sensory properties, high content of bioactive compounds with health-promoting properties, and are manufactured using traditional methods from natural ingredients. However, genetic biodiversity is vulnerable to many threats such as turn towards the intensive way of breeding and treatment (high milk and meat yield require a special way of feeding and treatment), and industrialized methods of production focused mainly on efficiency and profit. As a result, consumers are offered foodstuffs with uniform and often bland sensory properties. On the contrary, farming of the native breeds of sheep and cattle gives not enough income and at the same time requires hard, mainly manual work and is usually time-consuming. Because of these reasons the population of Polish Red cows and sheep during the last decades has decreased significantly. Therefore, many efforts should be taken to avoid these negative changes and to protect our genetic heritage. One of the strategies is to promote regional, traditional milk, and meat products derived from these breeds and to increase consumer awareness about their outstanding sensory properties and nutritional quality. At this moment, traditional products from the Polish Carpathian region are hardly available on the market and not as popular as traditional products derived from ewe's milk in other European countries e.g. French Roquefort or Greek Feta.

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18

Genomic insight into Pinzgau cattle biodiversity as a bioindicator of local cultural heritage in Slovakia

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Abstract. Identification of genomic regions affected by positive or natural selection serves as an indicator to distinguish autochthonous (local) farm animal populations. Selection signals are usually associated with specific biological and production traits and could impact future survival in the context of the traditional way of farming, life, and cultural heritage as a whole. We have used several methods to assess evidence of positive selection, including analysis of population stratification, integrated haplotype score statistics, and runs of homozygosity distribution scanning in the genome. An alternative approach to determinate genomic regions connected to adaptive fitness by principal component analysis has been proved. Based on applied methodologies, we can significantly distinguish closely related populations as Slovak and Austrian Pinzgau cattle, where several genomic regions reflected different selection directions. Detected signals were located close to the genes controlling body conformation, milk production, and immune response as footprints of breed development in the local environmental conditions. To distinguish other breeds (e.g. Slovak Spotted, Tyrol Grey, Cika) signals in the regions controlling coat colour were identified. The presented methodology proved the ability to distinguish closely related breeds in the context of cultural heritage and its applicability to different populations and species, including plants.

Keywords: high-density SNP data • livestock diversity • local populations • selection footprints

18.1. Introduction

18.1.1. Genome response to selection

In cattle, similarly to other livestock, natural and artificial selection together with adaptation to different environmental conditions and production circumstances affected mainly allelic frequencies of loci associated with adaptation and variability of production traits under selection [Randhawa et al. 2016].

According to the natural selection theory, the majority of molecular variants within and between breeds are selectively neutral, i.e. not affecting the fitness of an individual. However, if a variant (newly generated by mutation or already present in the genome) provides the individual with a preferable fitness against other individuals in the population, then the frequency of such superior genotype or allele in that population will increase because it gives to individual selection advantage in mating compared to others [Utsunomiya et al. 2015]. On the other hand, even if genetic variants do not give the individual a selective advantage against others, their frequency in the population could be increased randomly, f.e. due to genetic drift [De Simoni Gouveia et al. 2014]. A similar effect on the cattle genome structure also has artificial selection when genetic variants responsible for improving the production and fitness traits of individuals according to the breed standard or production direction of particular breeds are selected either indirectly (traditional phenotypic selection) or directly (marker-assisted selection) [Utsunomiya et al. 2015].

Natural and artificial selection has therefore essential impact on the cattle genome structure and generally on genetic diversity of all breeds. The principle of their impact on the genome is almost the same, i.e. only the best individual is involved in the breeding respectively mating, thereby substantially increasing the frequency of alleles that it carries in its genome. Following the identification of such regions under intense selection pressure, especially positive selection, has outstanding importance in genomics, population genetics, and animal breeding. The main goal of identifying regions affected by selection is to understand better evolutionary processes, which have formed and continually forming the bovine genome as well as to obtain detailed information on functional genes and genomic regions. The analysis of selection signals ultimately makes it possible to understand better the effects of the factors that have caused the enormous phenotypic variability observed between cattle breeds farmed in the present [The Bovine HapMap Consortium et al. 2009, Utsunomiya et al. 2015]. Moreover, such analysis could help in the detection of biological functions of genes affected by selection, contributing to increased adaptation and production traits of animals with subsequent application of knowledge into breeding practice to improve the quality of particular breed production [De Simoni Gouveia et al. 2014].

18.1.2. Selection footprints in the cattle genome

Each form of selection causes specific changes in the genome, which manifest themselves both in the selected loci and at the same time in the neutral loci that are linked to them. Directional or one-way selection, which is frequently used in cattle breeding, could either favour alleles affecting phenotype (positive selection) or discriminate (negative or purification selection) [Voight et al. 2006]. Positive selection results in the fixation of alleles that have some advantages over other alleles because they control a particular phenotypic expression important, for example, for the fitness or production level of an individual. In addition, the frequency of neutral alleles localized in the genome near them (the loci are linked to each other) also increases. This phenomenon is called the hitch-hiking effect or footprints of selection. The occurrence of such regions affected by selection may reduce heterozygosity in a given genomic region associated with the selected locus or increase the linkage disequilibrium resulting in the formation of long haplotypes. The level of diversity of genomic regions under positive selection tends to decrease at the intra-population level and vice versa to increase at the inter-population level [Qanbari and Simianer 2014].

In the case of negative selection, detrimental mutations are usually eliminated from the population gene pool before they reach a detectable frequency. Along with detrimental genetic variants, the neutral variants (alleles) that are linked to them are often eliminated. If the recombination process in this region slows down or the population is highly inbred, then this type of selection sometimes also reduces the genetic variability around the eliminated genomic regions [De Simoni Gouveia et al. 2014].

Stabilizing selection favours certain types of polymorphisms. In addition to such polymorphism at the selected locus, this type of selection also results in an increase in diversity at very tightly linked neutral loci. Stabilization selection usually results in an increase in the intra-population genetic diversity and a reduction in inter-population diversity, consequently causing a decrease of inbreeding between populations [Sanjak et al. 2018].

18.2. Methodological approaches to identify selection footprints

In the age of 'genomic information', it is possible to follow the effect of natural or artificial selection also without phenotypic information. Therefore, the detection of selection signatures is also described as the 'genome to phenotype' approach, which includes statistical evaluation of genomic information without reflecting the phenotype of an individual to identify target selection regions. Selection signatures could be identified either in non-coding or coding regions or in both depending on a statistical approach [Qanbari and Simianer 2014]. The choice of the method for identifying regions under selection pressure depends on the nature of the selection signals as well as the time during which the genome was exposed to the selection. The number of selection signals could be therefore affected by different factors, including selection intensity, recombination rate, and the relative 'age' of the neutral alleles linked to the loci affected by the selection. Methods for detecting loci under selection are divided into several groups based on a methodological approach, e.g. synonymous and non-synonymous substitution rate testing, frequency spectrum testing, linkage disequilibrium testing, and population differentiation testing. The most widely used methods currently include testing based on genetic differentiation, linkage disequilibrium (LD), and distribution of homozygous or heterozygous regions in animal genomes.

18.3. Results and discussion

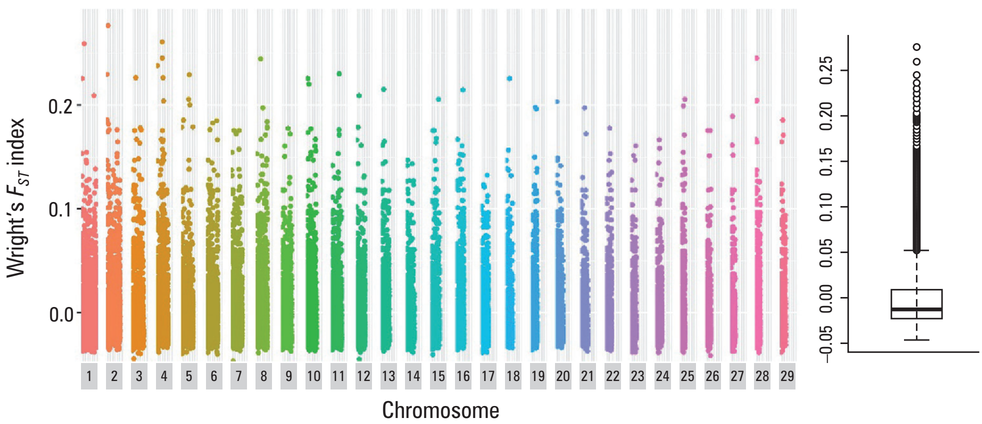
18.3.1. Selection footprints resulting from population differentiation

18.3.1.1. Wright's F statistics

One of the most often used methods is Wright's F statistics (calculation of genome-wide F_{ST} index), which is based on the comparison of differences in allele frequencies between populations. This method allows evaluating not only the effects of recent selection but also the selection that occurred from 2000 to 3000 generations in the past [Sabetti et al. 2007]. Wright's F_{ST} index could be described as the level of differentiation or fragmentation of population, which is expressed as a decrease of heterozygosity in subpopulations due to genetic drift and it serves to assess the overall genetic differences between subpopulations. It is also called a relationship coefficient and is defined as a correlation between gametes in subpopulations relative to randomly selected gametes in whole populations [Weir and Cockerham 1984].

Theoretically, the F_{ST} values varied from 0 to 1, when both extremes mean the total identity (F_{ST} = 0) or differentiation (F_{ST} = 1) within populations analyzed. The selection signatures could be recognized when adjacent loci all show high F_{ST} due to the hitch-hiking effect resulting from the divergent selection or when adjacent SNPs all show low F_{ST} resulting from the balancing selection between populations [Qanbari et al. 2011].

The application of F_{ST} statistics to detect the effects of selection on the genome is well described, e.g. in Holsinger and Weir [2009]. Several modifications of this method using various modern technologies are already available [Fumagalli et al. 2013]. When comparing these approaches as well as different SNP datasets, some differences were found between F_{ST} estimates [Bhatia et al. 2013]. Despite that, this indicator is considered to be one of the most suitable for assessing the genomic signals of positive selection resulting from genetic differentiation between selected populations.



Source: Kasarda et al. [2015]

Fig. 18.1. The distribution of F_{ST} values within the autosomes

This approach was used to identify genomic regions defining differences in the genome of the Slovak and Austrian Pinzgau cattle and the analysis clearly showed that despite the relatively strong historical connection between them, they could be considered as genetically different. As can be seen in Figure 18.1, the most significant differences in the genome structure were found on the autosomes BTA1, BTA2, BTA4, BTA5, BTA10, and BTA28. The autosomal regions were recognized as affected by positive selection when the adjacent SNPs showed F_{ST} values higher than 0.20. The observed F_{ST} values ranged from –0.05 to 0.28, with an average value of 0.0005. In total, 76.23% of F_{ST} values were lower than 0.01. Subsequently, the F_{ST} values were averaged over 8-wide SNPs widows within each autosome to determine a global pattern of F_{ST} across the genome. More than 95% of clusters across all autosomes showed F_{ST} values lower than 0.01. Therefore, the results indicated unimodal distribution and pretty much uniform scheme of selection in all loci included in analysis.

The F_{ST} outlier approach implemented in software LOSITAN [Antao et al. 2008] was also used to identify loci under directional (positive) or balancing selection. The locus-specific F_{ST} values significantly differing from the average as a signal of genomic regions under selection pressure. The loci under selection were recognized if the genome-wide distribution of F_{ST} values was unusually high (directional selection) or low (balancing selection) than expected. This approach pointed to the fact that most of the outlier loci can be considered as directional outliers (1,278), whereas 324 markers were identified as balancing outliers. Similar to previous results, the highest proportion of SNPs subject to positive resp. balancing selection showed chromosomes 1 (7.43%) and 4 (6.31%). From these, a total of 17 loci were located within the sequences of protein-coding annotated genes (Table 18.1).

Table 18.1. Outlier loci under intense selection pressure resulting from the Wright's *F* statistic

BTA	Position (Mb)	No. of SNPs	Annotated genes in regions
1	153.75–154.30	4	Calpain 7 (*CAPN*)
2	6.7	3	Myostatin (*MSTN*)
	105.35–107.46		Insulin-like growth factor-binding protein (*IGFBP*) Cytochrome P450, family 27 (*CYP27A1*)
4	65.48	1	Growth hormone-releasing hormone receptor (*GHRHR*)
5	67.78	1	Insulin-like growth factor 1 (*IGF1*)
6	87.2	1	Casein beta (*CSN2*)
10	59.23	1	Cytochrome P450, family 19 (*CYP19A1*)
11	6.65–7.21	3	Interleukin family
12	88.13	1	Collagen type IV alpha 1 chain (*COL4A1*)
13	26.86	1	Myosin IIIA (*MYO3A*)
23	25.59	1	Major histocompatibility complex, class II (*BOLA-DRA*)

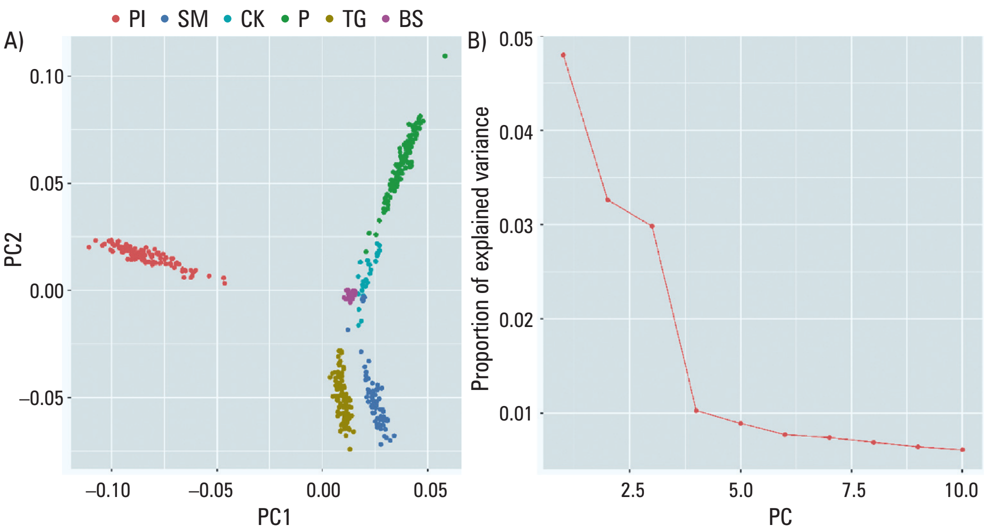
Source: Kasarda et al. [2018a]

18.3.1.2. Principal component analysis

Positive natural selection or local adaptation is the driving force behind the adaptation of individuals to their environment. To provide a list of variants that are potentially involved in natural selection, genome scans measure the genetic differentiation between populations considering that extreme values correspond to candidate regions [Duforet-

Frebourg et al. 2016]. Although high levels of differentiation can have various causes, the adaptation of individuals to their local environment is a prominent explanation to such patterns of differentiation for adaptive loci exceeding neutral expectations. One of the alternative approach to determine candidate markers for natural selection is the use of principal component analysis [Duforet-Frebourg et al. 2014].

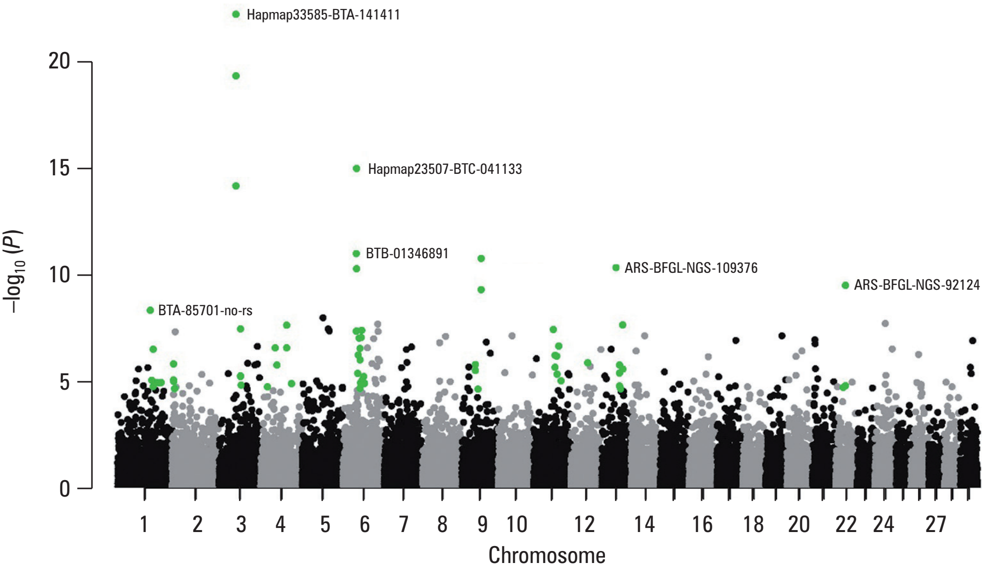
Principal component analysis (PCA) is probably the most popular multivariate statistical method, used in the majority of scientific branches, including genetics. PCA analysis presents a way of oversize data displaying, f.e. genotyping information about individuals and populations, in the lower number of dimensions. This analysis has become popular in particular as a tool for summarizing large genomic data while providing random variables, which could improve information about population structure, mainly through detection of principal factors explaining genetic variability in populations with a high number of individuals. Moreover, the obtained correlations between genetic variants and each principal component provide a conceptual framework to identify the variants involved in local adaptation without prior information of population structure [Duforet-Frebourg et al. 2016]. The PCA based statistic provides three main advantages compared to the F_{ST} approach: works on an individual basis, the computation time is reduced in comparison to methods that use the MCMC algorithms and candidate loci can be related to the different evolutionary events which correspond to the different principal components [Duforet-Frebourg et al. 2016, Luu et al. 2016].



Source: Moravčíková et al. [2018a]

Fig. 18.2. The scatter-plot representing the population structure (A) and the proportion of variance explained by 10 PCs (B) (Brown Swiss – BS, Tyrol Grey – TG, Pinzgau – P, Cika – CK, Simmental – SM, and Piedmontese – PI)

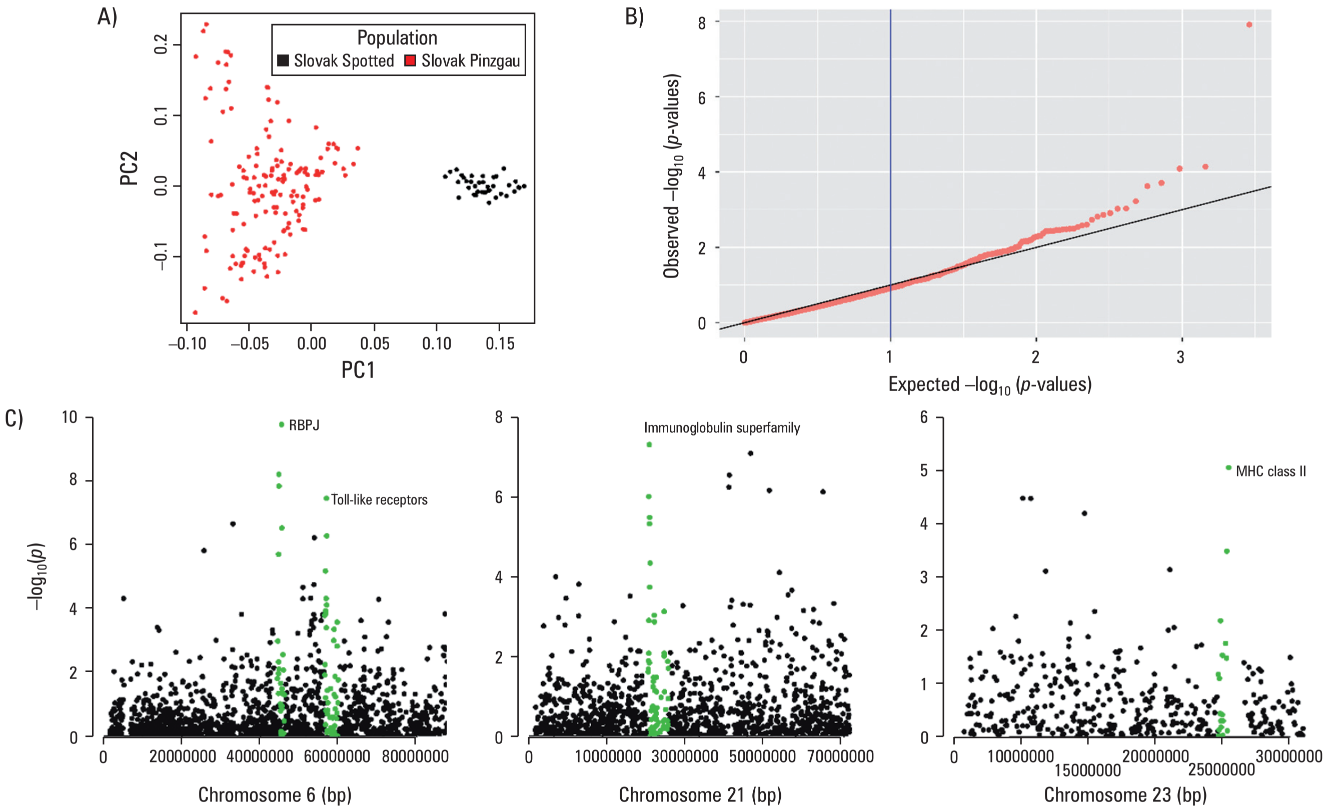
This approach has been used in comparative analyses to detect differences in the genome structure of historically or geographically connected populations of Slovak Pinzgau, Austrian Pinzgau, Brown Swiss, Tyrol Grey, Cika, Simmental and Piedmontese cattle [Moravčíková et al. 2018a, b]. As expected based on the population's origin, the first and the second principal components separated the population structure to the six genetic clusters (Fig. 18.2A). The Slovak and Austrian Pinzgau populations were linked into the one group mainly due to the high genetic similarity between them that can be attributed to the common ancestors. The decay of eigenvalues confirmed to use of K = 6 as optimal because the eigenvalues decreased between K = 5 and K = 7 (Fig. 18.2).



Source: Moravčíková et al. [2018a]

Fig. 18.3. The Manhattan plot of $-\log_{10}$ (p-values). The outlier loci characterizing the strongest signals of selection are coloured in green

Figure 18.3 shows a Manhattan plot indicating the main outlier SNPs (coloured in green) that have been detected using the genome scan for footprints of natural selection. Based on the expected false discovery rate equal to 10%, it was possible to detect 1,138 outlier SNPs distributed across all autosomes, in a total of 322 genomic regions. The most reliable signals of selection (P < 0.0005) were found within eight genomic regions located on BTA1, BTA2, BTA3, BTA6, BTA9, BTA11, BTA13, and BTA22. Most of the genes identified within these regions have been previously associated mainly with immunity system (*IL12A*, *IL5RA*, *SERP1*), body growth (*GHSR*,



Source: Moravčíková et al. [2018b]

Fig. 18.4. The scatter-plot representing the population structure based on the first two principal components A), distribution of p-values based on the Q-Q plot B) and the Manhattan plots of –log10 (p-values) for BTA6, BTA21, and BTA23. The outlier loci characterizing the strongest signals of selection are coloured in green

GFI1) and muscle formation (*MSTN*, *MYO7B*, *CAPN13*). Even if all studied SNPs within a particular region did not reach cut-off value, the multiple signals of selection could be expected in such region mainly due to the impact of artificial selection.

Only SNPs located on BTA6 (1.72–87.76 Mb), BTA21 (6.1–71.59 Mb) and BTA23 (6.98–30.50 Mb) were selected to obtain a more detailed view on genomic regions controlling adaptive and innate immune response in Slovak Spotted and Slovak Pinzgau cattle (Fig. 18.4). The analysis was based on the assumption that loci extremely related to the population structure being also candidates for local adaptation of the population. Based on the false discovery rate equal to 10% up to 213 loci were identified as outliers. Most of them were found on BTA6 (118) in the two genomic regions within a sequence of genes encoding Toll-like receptors (*TLR1*, *TLR6*, *TLR10*) and Immunoglobulin J chain (*RBPJ*). On BTA21, the strongest signal was detected directly within a sequence of the immunoglobulin superfamily (*ISLR*, *ISLR2*). The lowest proportion of outlier loci was found on BTA23 (13) mostly within region controlling Major histocompatibility complex (MHC). Our results indicated that the signals of selection in genomic regions responsible for adaptive and innate immune response across tested cattle breeds resulted mainly from the correlated selection response in a way to maintain their fitness. Compared to conventional breeds, the allele frequency differences can be expected in identified genomic regions.

18.3.2. Selection footprints resulting from the variability in allele frequencies in target haplotypes

For identification of selection signatures through the level of LD were prepared several tests [Sabeti et al. 2002, Kim and Nielse 2004, Voight et al. 2006, Kimura et al. 2007]. However, these selection signals have a temporary tendency in some cases because recombination can cause a change in the sequence of the selected locus before it is fixed. One of the approaches for the detection of selection signals is the LRH test (long-range haplotypes), which evaluates the relationships between allele frequencies and LD levels. This test is based on the identification of target haplotypes (through the genotyping of SNP markers in small genomic regions without recombination). Subsequently, other SNPs are also analyzed with increasing distance from the target haplotypes to assess the decrease in LD based on the genetic distance. The level of LD with increasing distance from the target haplotypes is evaluated by calculating the value of EHH (extended haplotype homozygosity), which represents the probability that the two chromosomes carrying specific target haplotypes are homozygous for the entire region, i.e. from the target distance to the distance x. The relative value of EHH (REHH) serves to compare the decrease in the EHH specific target haplotype with the decrease in EHH in all other haplotypes. The comparison of the REHH value and frequency for each target haplotype with the REHH values and frequencies of the other target haplotypes is then used to test for the impact of selection on the genome structure. If the target haplotype has a high REHH value as well as the frequency in the population, such a haplotype can be described as a positive selection footprint [Sabeti et al. 2002].

Another test for identifying selection footprints is based on the integrated haplotype score (iHS) statistics and has been prepared especially concerning more and more frequent SNP genotyping using high-density arrays. The iHS value can be defined simply as a measure of how unusual a haplotype consisting of certain SNPs is compared to the rest of the genome. In this approach, each SNP is evaluated as a target. The test begins with a calculation of EHH values for each SNPs. SNPs as biallelic loci can be either inherited (ancestral) or derived. The calculation determines the integral of the observed decrease in the EHH of the target SNP until it reaches EHH equal to 0.05. This value is considered to be an integrated EHH (iHH) and is identified as iHH_A or iHH_D depending on whether it was calculated from the ancestral (A) or derived allele (D) of the target SNP. The obtained value is standardized for direct comparison with other SNPs regardless of allele frequencies [Voight et al. 2006].

The next method is based on haplotype allelic classes (HAC). This indicator is defined as the sum of allelic differences between the allelic reference categories and the individual haplotypes in the sample. Positive values, in this case, indicate positive selection in a given genomic region [Hussin et al. 2010].

The LRH and iHS tests are based on allele frequencies in target haplotypes and are therefore limited compared to other approaches, especially if the selected allele is fixed. If the selected allele is fixed in one population but remains polymorphic in another, the LRH test could result from a comparison between those populations. XP-EHH statistics is defined as the normalized ratio of logarithms between I_A and I_B, where I is the integral of the observed decrease in EHH from target SNP to SNPx (which has an EHH value closest to 0.04 in both populations) in population A and I_B represent the same calculation, but in case of population B. A very similar principle is used in a method called as ln(Rsb) statistics [Sabeti et al. 2007, Tang et al. 2007].

The identification of regions under intense selection pressure based on the integrated haplotype score statistics was tested on models of Slovak and Austrian Pinzgau cattle. The iHS score was calculated for each SNPs and averaged into non-overlapping 500 kb segments across the genome. The size of sliding windows was chosen based on a sufficient number of SNPs for each segment. Genomic regions were considered to be recently affected by selection when the iHS score of multiple loci located within 0.5 Mb was higher than 1.7. Table 18.2 shows identified autosomal regions displaying significant iHS values.

Table 18.2. Outlier loci under intense selection pressure resulting from the iHS statistics

BTA	Position (Mb)	No. of SNPs	Annotated genes in regions
1	65.66–65.99	3	Homogentisate 1,2-dioxygenase (*HGD*)
5	55.58	1	*LOC101904412*
7	12.83	1	DDB1- and CUL4-associated factor 15 (*DCAF15*)
9	72.11–72.31	2	Eyes absent homolog (*EYA4*)
15	52.03–52.47	7	Nuclear mitotic apparatus protein 1 (*NUMA1*)
18	22.26–22.38	2	Fat mass and obesity-associated gene (*FTO*)
19	0.47	1	Carbonic anhydrase 10 (*CA10*)

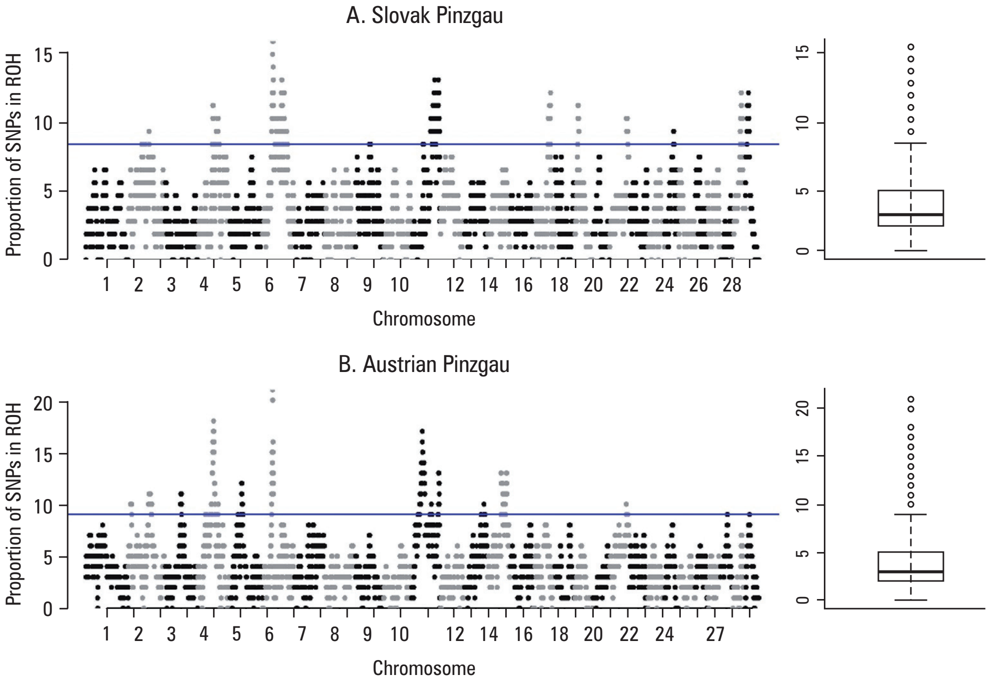
Source: Kasarda et al. [2015]

The average value of iHS score was 0.05 and the highest score (2.24) was identified for a region on chromosome 7 with only one observed locus. In this genome location, the genes encoding *DDB1* and *CUL4* associated factor 15 were found. Most of the SNPs that showed significant iHS values were located on chromosome 15 in the genomic region ranged from 52.03 to 52.47 Mb. In this bovine autosomal region, the nuclear mitotic apparatus protein 1 (*NUMA1*) gene conserved across different species, including human, is located. The *NUMA1* gene was tested for evidence of its role in the proliferative activity and meiotic cell division [Taimen et al. 2004]. The region on chromosome 18 consisting of only 2 loci was near to the *FTO* (the fat mass and obesity-associated gene) gene which was significantly associated with carcass traits and meat quality in cattle and pigs [Zhang et al. 2011, Dvořáková et al. 2012].

18.3.3. Selection footprints resulting from the runs of homozygosity distribution

Runs of homozygosity (ROH) are continuous homozygous regions in the genome of individuals or populations. The identification and analysis of these regions provide an insight into the changes that shaped the genome of populations and represent a useful tool for assessing demographic history during the development of a particular population. ROH segments could also be used to assess genetic relationships between individuals, help minimize the rate of inbreeding and identify alleles or genetic variants that were erased from the genome. The frequency, size and distribution of ROH in the genome are affected by several factors, including natural and artificial selection, recombination rate, linkage disequilibrium, population structure, mutation rate and level of inbreeding. The identification of selection footprints follows from the assumption that regions with a high proportion of ROH mainly reflect the effect of selective breeding for specific traits of interest, defined in the breeding standards of the breeds studied [Curik et al. 2014, Kim et al. 2017]. Resulting ROH segments located in the genome close to each other have arisen or arise mainly due to the existence of alleles derived from common ancestors, which are inherited from generation to generation [Biscarini et al. 2014].

In Pinzgau cattle, based on previous extensive studies [Ferenčakovic et al. 2013a, b, Curik et al. 2014], autozygous regions have been defined as specific genomic regions with extreme allele frequency in ROH with a minimum length of 4 Mb, corresponding to the proportion of autozygosity derived from ancestors approximately 12 generations ago. Based on the graphical visualization of the values obtained using box-plot plots, the cut-off values were subsequently determined for the identification of individual selection signals (Fig. 18.5). In Figure 18.5, it can be seen that the distribution of selection signals in the genome of both Slovak and Austrian Pinzgau cattle was not uniform and depended on the particular breed.



Source: Kukučková et al. [2017], Kasarda et al. [2018b]

Fig. 18.5. Incidence of common runs for each SNP as signals of recent selection reflecting breeding programs of Slovak Pinzgau (A) and Austrian Pinzgau cattle (B)

Table 18.3. Outlier loci under intense selection pressure resulting from the ROHs scanning in Slovak Pinzgau cattle

BTA	Position (Mb)	No. of SNPs	No. of genes	QTL traits
2	49.81–51.90	32	6	Marbling score, Milk yield
	53.43–55.48	47	7	Marbling score, Milk yield
	60.09–63.78	52	20	Marbling score, Milk yield, Functional herd life
4	54.55–59.33	79	24	Somatic cell score
	60.92–61.73	20	9	
	65.40–80.71	235	163	Teat length, LMA, Marbling score
6	37.10–42.99	110	25	Birth weight, Milk yield, Protein and fat yield, Protein and fat percentage, Stature, Strength, Daily gain
	49.21–59.31	178	30	Birth weight, Yearling weight, Stature, Strength, Marbling score, Milk yield, Protein and Fat yield, Protein and fat percentage
	65.34–69.88	77	53	Stature, Strength, Body, Rump width, Suspensory ligament, Teat placement, Foot angle, Quality of udder, Quality of feet and legs, Udder depth, Milk yield, Protein and fat yield, Protein and fat percentage, Pre-weaning average daily percentage
	71.91–73.31	30	19	
	79.84–88.59	115	83	
	90.56–93.94	66	57	
9	53.77–57.95	85	15	Milk yield, Protein and fat yield
11	71.34–77.56	84	108	Yield grade
	79.17–91.88	176	78	Fat yield, Pelvic and heart fat
	93.29–103.62	160	249	
16	56.49–66.22	160	105	Fat depth, yield grade, Hot carcass weight
18	10.83–16.03	69	109	Dystocia (maternal effect), Hot carcass weight
20	62.05–68.20	123	36	Meat tenderness, Milk yield, Protein percentage
28	27.46–37.20	149	110	Protein and fat percentage
29	6.69–15.49	140	54	Milk speed, temperament, Milk yield, Birth weight

Source: Kasarda et al. [2018b]

A detailed description of the identified regions with the extreme frequency of ROH in Slovak Pinzgau cattle, including the number of SNP markers and QTLs, is given in Table 18.3. For the Slovak Pinzgau cattle, a total of 21 genomic regions with extreme ROH frequencies on BTA2, BTA4, BTA6, BTA11, BTA16, BTA18, BTA20, BTA28, and BTA 29 were detected. The strongest ROH pattern was identified on BTA4 in the region from 65,400,608 bp to 80,706,119 bp that included QTLs affecting teat length [Ashwell et al. 2001], longissimus muscle area and marbling score [Mizoshita et al. 2004]. From this, some selection signals are unique for the genome of the Slovak Pinzgau breed (BTA16, BTA18, BTA23, BTA28, and BTA29). Generally, in target regions of selection, some of the genes involved in multiple signalling and signal transduction pathways in a wide variety of biological processes were identified, including those responsible for the genetic control of milk production and reproduction (*LCT*, *CSN1S1*, *CSN1S2*, *CSN2*, *CSN3*, *BMPR1B*), body conformation and meat quality (*GHRHR*, *POMC*, *MYO1G*), coat colour (*MCR1*, *KIT*) and immunity response (*IGFBP*, *IGJ*, *MR1*, *TLR10*, *TLR6*).

18.4. Conclusions

Obtained results showed that the identification of selection signatures spread across the genomes of various cattle breeds is an effective indicator to reliably distinguish between closely related breeds in the context of small homelands cultural heritage preservation in the future. Detected signals close to genomic regions controlling production traits reflected mostly the intensity of artificial selection resulting from the breeding objectives of each breed analyzed as well as the impact of natural selection related to animals' adaptation to local environmental conditions. Moreover, the presented methodology is universal and can be applied to recognize unique genomic regions for any other farm animal or free-range species, including plants.

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The significance of macrofungi, especially from *Lactarius* spp., in the culture of south-eastern Poland rural areas

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Abstract. Macrofungi have long been used in households, but due to the progressing socio-cultural changes, the way of their use has been changed. In the past, they were often used for healing, consumption, and folk rituals, but nowadays their use is limited to consumption only. One of the most popular mushrooms consumed in Poland is them from *Lactarius* family. They occur under clean environmental conditions, under firs, spruce, and pines. The *Lactarius* spp. are collected mainly in mountainous areas. In the Carpathian region, the most popular species from this family is *Lactarius delicious* ('rydz'). In this region people also consumed other species from *the Lactarius* family, like *Lactarius piperatus, Lactarius volemus, Lactarius salmonicolor, Lactarius deterrimus*. In nineteenth century wealthy people knew and ate *Lactarius delicious*, while folk people *L. vellereus* and *L. piperatus*. Some methods of eating and preservation *Lactarius* spp. were typical for Poland (lactic acid fermentation, pickling, frying), but some were typical only for the Carpathian region (eating as raw with salt, backing on the oven stove lid). Due to the progress of civilization, most of these methods are not used today. Mushrooms from *the Lactarius* family were used in medicine too, for example, fresh *Lactarius deliciosus* were applied to ulcers.

Keywords: culture • mushrooms • *Lactarius* spp. • Carpathian region • chemical composition • processing

19.1. Introduction

In recent years in the world, there has been a growing interest in the use of edible mushrooms. This phenomenon is the result of recent scientific research that shows that the fruiting bodies of edible mushrooms are not only a source of unique sensory features, but also of many biologically active compounds, including antioxidant, anti-cholesterol, anti-inflammatory, anti-bacterial, anti-viral, and immunostimulatory. These compounds include polysaccharides (beta-glucans), dietary fiber, terpenes, peptides, glycoproteins, alcohols, mineral elements, unsaturated fatty acids, antioxidants like phenolic compounds, tocopherols, ascorbic acid, B-group vitamins. Despite numerous scientific studies, most Europeans, including Poles, still treat mushrooms only as a source of desirable sensory features (taste, smell, consistency), not functional compounds [Cheung 2008, Wasser and Weis 2009, Kalac 2013, Wang et al. 2014, Rathore et al. 2017].

The Carpathians Mountains belong to one of the richest areas of Poland in terms of nature. They include several national parks and dozens of nature reserves. In Poland, as well as in other Northern European Slavic countries (including Ukraine, Belarus, Czech Republic, Slovakia), there is a tradition of collecting, eating and processing mushrooms from their natural state. This tradition has been passed down from generation to generation and may constitute the cultural heritage of a given region. Grandparents or parents teach the young generation how to recognize edible mushrooms species and find their place of occurrence. Many Polish people not only consumed mushrooms, but they are also widely known and recognized, people talked about them and even frequently depicted in children's illustrations. In the old days, collecting of wild-growing mushrooms was an additional, and sometimes even the main, source of income for the villagers. Today, mushroom picking is a form of spending actively free time, which is associated with the ongoing economic development of rural areas.

The number and species of collected edible mushrooms in the world are different, thus nationalities can be divided into hydrophilic or mysophobia [Peintne et al. 2013]. Poland, like other European Slavic countries (including the Czech Republic, Slovakia, Ukraine), is included in the mycophilic. In turn, mysophobia is mainly Germanic-speaking countries (United Kingdom, Ireland, Netherlands, Germany). Mycophilic countries, unlike mysophobia, have their legislation on mushroom commerce. In mycophobic countries, people consumed mainly cultivated species of mushrooms

(*Agaricus bisporus*, *Pleurotus ostreatus*, *Lentinula edodes*), while in mycophenolic cultivated and wild-growing [Kotowski 2016]. In Poland, 47 species of edible mushrooms are currently authorized [Regulation 1, 2018], of which the vast majority are wild-growing species. According to mushroom growing guides, the number of wild-growing species of edible mushrooms in Poland is estimated at 170, with according to Professor Grzywacz it is even about 1,400 species [Kotowski 2016]. One of the most collected mushrooms in Poland are those from the *Boletus*, *Xerocomus*, *Suillus*, *Leccinum* and *Cantharellus* families, and to a lesser extent from the *Agaricus*, *Lactarius*, and *Morchella* families. It should be emphasized that the occurrence of individual species is not the same across the country and largely depends on soil and weather conditions. *Lactarius deliciosus* and *Boletus edulis* in particular, are important non-wood forest products worldwide.

19.2. Traditions in collecting of mushrooms in Poland and in the world

Obtaining the edible mushrooms from the natural environment is a distinctive and characteristic feature of a given nationality. In Poland, the tradition of mushrooms collecting dates back to the beginnings of the state, i.e. around 1000 A.D. [Grzywacz 2015]. Mushroom picking and consequently their composition may be related to differences in defining the edibility status of some mushroom species. An example would be the *Boletus calopus*, which, e.g. in Russia is considered edible, and in Poland, and Slovenia is considered poisonous. Similarly, *Gyromitra esculenta* is considered as a delicacy in Finland, edible mushroom in Russia, but poisonous in Poland (as an edible was considered in Poland in the past) [Boa 2004, Grzywacz 2015]. Also, some species of *Lactarius* spp. are considered edible in some regions of the world, and inedible or poisonous in others. An example would be *Lactarius piperatus*, which is widely eaten in Turkey, Russia, Ukraine, Bulgaria, Romania, and in some regions of Poland too, but in other European countries, this mushroom is viewed as inedible [Kotowski 2016]. In the Carpathian region, one of the species that was formerly considered edible, while nowadays is considered poisonous was *Paxillks involutus* so-called 'olszówki' [Ceklarz and Kroh 2016].

In other regions of the world, like in Poland, there is also a tradition of collecting mushrooms from the natural environment, including primarily in China, but also in Chile, Mexico, Nepal, Turkey, Malaysia, Papua New Guinea and in African countries [Boa 2004, Christensen et al. 2008]. For example, in Nepal 228 species of wild-growing fungi are confirmed to be used for food, and picking is most widespread among the high-mountain Tibeto-Nepalese ethnic groups. In this country, the most important species for export are morels (mainly *Morchella conica*). Inhabitants of this region also collect and consume *Lactarius* spp., especially *L. deliciosus* which is one of the most important species on the international market [Christensen et al. 2008]. In India, *L. camphorates*, *L. piperatus*, *L. volemus*, *L. hygrophoroides* are dominate, while *L. picinus*, *L. gerardii*, *L. deterrimus* are rare. Out of a total of 68 taxa (56 species and 12 varieties) 34 prefer deciduous, 13 prefer coniferous and only 13 grow in both types of forests, while only 2 grow in grassy grounds. In the tropics, *the Lactarius* genus is much reduced. In contrast to the tropical areas, Himalayan temperate forests were found to have more variations of *Lactarius*, probably because of the presence of oaks, which are the well-known mycorrhiza mushrooms hosts [Das and Sharma 2002].

19.3. The use of edible mushrooms in the household and for medicinal purposes

In the old days, edible mushrooms were used in the household for consumption, but also in folk medicine. It was believed that they have a relationship with impure force, with the afterlife and magic. Picking of mushrooms was a peculiar rite, combined with many commands and bans, most often irrational. For example, it was believed that mushrooms grow in a foreign and threatening space (forest), therefore they belong to the impure and demonic sphere. This is where the names of mushrooms, such as ‘satan’ (*Rubroboletus satanas*), come from. Nowadays, collecting mushrooms is most often treated as a hobby, as a way of spending free time actively.

The beliefs of the rural population were associated with dishes that were made from mushrooms. An example would be the preparation of Christmas Eve dishes from them because according to beliefs mushrooms were an extraordinary dish during Christmas Eve. People believed that if they eat mushrooms with cabbage or potatoes, their lands and homes are visited by deceased ancestors. Some of the old dishes have survived in Polish cuisine to this day, but many have already been forgotten. An example of such a dish was cabbage with mushrooms. In old Poland, the mushrooms *Boletus edulis* (‘prawdziwki’), which in Poland were considered (and still are) for the noblest and tastiest species, were appreciated above all. *B. edulis* were primarily dried and mostly sold in this form. Other species of fungi, including *Lactarius deliciosus* (‘rydz’), were used for their purposes in the household. In villages located in the foothill region of southern Poland, the mushroom was used, among others, as an ingredient in stuffing (dumplings, stuffed cabbage rolls), soups, sauces. From dried, boiled mushrooms and sauerkraut, stuffing for Christmas Eve dumplings was prepared; mushrooms were cooked for borscht too. In addition, to the listed species, others such as *Sarcodon imbricatus* were also used. This species was called in the dialect ‘cygany’, and dried was added to boiled cabbage (nowadays this species threatened with extinction). Other examples could be: *Lactarius piperatus* so-called 'biele', which was baked on the oven stove lid, *Cantharellus cibarius* so-called 'lisówki' most often eaten with scrambled eggs or in the form of a soup, *Neoboletus luridiformis* so-called 'pociece' fried after cooking and *Morchella esculenta* so-called 'smardze', the first spring mushrooms consumed both fresh and dried. The most popular method of preserving forest mushrooms was drying. Some of the mushrooms were dried in the sun, others spread on wooden sticks or above the stove, threaded on a string, or stamped on a plank. A plank with nails called 'sceci', with similar construction as the tool used for combing flax, was studded with mushrooms and set on the oven tin, or the floor by the oven. After drying, mushrooms were stored in linen bags in a ventilated place [Szymańska 2012].

Dishes made from dried mushrooms were particularly popular in early spring when soups were cooked from them ('kapuśniorka', 'żur'), or they were added to other dishes from plants, e.g. potatoes, legumes, 'krup', noodles. Fresh mushrooms of the *Lactarius* genus were baked on the oven stove lid or pan. It should be emphasized that at that time mushrooms were treated as a delicacy and therefore rarely go to the peasant tables [Ceklarz and Kroh 2016]. For longer storage mushrooms were also salted and fermented using lactic acid fermentation. It should be emphasized that mushroom consumption was particularly popular among the rural population during periods of food shortage.

To preserve the tradition of collecting mushrooms and preparing dishes from them in many regions of Poland, including the south-eastern Poland, various events are organized. An example is the annual 'Feast of Rydz' (Wysowa Zdrój) or 'Borzęcki Feast of Mushroom' (Borzęcin). The basic point of these events is mushroom picking, but also regional dishes from mushrooms are presented, including soups, sauces, dumplings. Mushrooms are a component of many registered regional dishes from the Carpathian region, e.g. 'kapuśniorki with mushrooms' (soup based on sauerkraut with mushrooms and potatoes, Łącko town), 'Rakszawski mushroom pate' (mushroom pate, Rakszawa town), 'dumplings with cabbage and Pilsen mushrooms' (Pilsen town) [List of traditional products...].

In the old days' mushrooms were also used in the household. An examples could be a lubrication of the axle of carts with fruiting bodies of *Suillus* spp., the use of dried fruiting bodies of *Fomes fomentarius* as kindling, and larger specimens as headgear. At the beginning of the 20th century *Amanita muscaria* were used as fly poison. The fruiting bodies were boiled in milk or water, mixed with sugar and placed on plates in rooms and barns. They also made a pulp, which was smeared in floors and walls gaps to get rid of bed bugs. For the same purpose the *Phallus impudicus* was used, a fungus which attracted flies with its unpleasant smell, was used. Polypores and puffballs were also used for incense bees. Mushrooms, especially those of unusual shapes and colors or unusual properties, were used for magical activities, e.g. to deter evil spirits and protect against spells, *Agaricus emeticus* was used. It was believed that mushrooms with strange, unusual shapes as *Gyromitra esculenta* have extraordinary power, and when worn on the chest, they protect man from charms.

In official medicine, mushrooms were used relatively rarely. Mushrooms with caps, mostly belonging to the Basidiomycete class, were found most frequently, among them fungi parasitizing on the trees (*Fomitopsis officinalis* on larch or *Fungus chirurgorum* on beech and birch), *Auricularia auricula-judae*, *Amanita muscaria*, *Lycoperdon* spp. and truffles. At the beginning of the 19th century, several species were used in medicine, and the subsequent development of knowledge meant that some of them were considered ineffective or completely devoid of therapeutic properties and replaced with drugs. It has often been the case that when selecting a drug, the principle was used that similar drugs treat similar ones. An example would be the use of *Amanita muscaria* to treat heart disease or dysentery. From fresh or dried *Amanita muscaria* fruiting body the alcohol tinctures were made. They were used externally to treat rheumatism and internally to treat diarrhea, dysentery, and heart disease. In this case, the red color of the mushrooms could be significant, because the tincture was only made on the skin, removed from the cap. The tincture was rubbed on sick, aching places, or drunk a few drops. It happens that this tincture is sporadically used to this day. The *Amanita muscaria* was also used to prepare soup, whose task was to support the heart and treat dysentery.

Fruiting bodies of *Fomitopsis betulin*a have been used as antibacterial, antiviral, and anticancer agents. The dressing made from crushed *Boletus edulis* mixed with milk was applied to wounds, boils, and ulcers; warm caps of this species were applied to ulcers, as a result of which they cracked. The mushrooms cooked in milk were also supposed to relieve breast inflammation in lactating women. Another species used in the household was *Lycoperdon* spp. Young fruiting bodies after cutting were used to dry fresh, bleeding as well as poorly healing old wounds. For the same purpose, spore from mature *Lycoperdon* spp. was used. *Lycoperdon* spp. spores had a healing effect, but it could cause eye inflammation or contribute to the appearance of warts on the skin. *Lycoperdon* spp. were also used as one of the ingredients of the drug, which was supposed to treat alcohol addiction: *take half a gallon of vodka and as much sour milk, mix it together with the addition of Lycoperdon mushrooms and give it to drink*. As dressing agents stopping bleeding, mushrooms growing on tree trunks were also used. After the proper treatment, consisting of the removal of the outer layer and breaking the middle layer, they were formed into patches, which due to their hygroscopic properties were used as dressings. The most commonly used was *the Fomes* spp. growing on old oaks and beeches. Mushrooms parasitizing on fruit trees, e.g. plum *Fomes* were mixed with oak bark, soaked in vodka, and served to drink for patients suffering from malaria. Another species that was used for medicinal purposes as *Inonotus obliquus* growing on birch trunks. These fruiting bodies were used as anticancer therapy. Decoctions of powdered fruiting bodies were prepared and given to patients to drink. Another way was to use the cut into thin slices mushrooms, which after boiling were applied to the diseased area or used internally. In unconventional medicine, herbalists are also currently using *Inonotus obliquus* to treat cancer. Some fungi were also considered to increase potency and were used as aphrodisiacs, e.g. *Tuber* spp., *Morchella*, and *Fungus cervinus* [Trojanowska 2001, Szymańska 2012].

19.4. Occurrence of *Lactarius* spp. in the world

The occurrence of edible mushrooms, including *Lactarus* spp. is associated with particular trees. Many species have gained the local names, specific to a given country or region. For example, in southern African people use the names: 'chimsuku' and 'kasuku', to describe *Lactarius* spp. that grow under *Uapaca kirkiana* trees. In turn, in Poland *L. salmonicolor* can be found mainly in mountainous areas, near the Pieniny Mountains, the Gorce Mountains, and on Babia Góra Mountain. It belongs to mycorrhizal mushrooms, forming a symbiosis with *Abies alba* [Skirgiełło 1998]. In North America and Africa contain the largest known diversity of *Lactarius* spp., with over 20 species reported for each continent. In Europe occurs only 10 species, in Asia, about 15 species have been described so far, of which 10 are from South-East Asia (Java, Papua New Guinea, Malaysia, and Singapore). It should be noted that, the picking of mushrooms from *Lactarius* spp. is the most important in high-altitude forest areas. The seasonal climate in northern Thailand is good for the presence of *Lactarius* spp. because he abounds in trees *as Quercus* spp., *Castanopsis* spp., *Dipterocarpus* spp., and *Pinus* spp. Few species of *Lactarius* have been recorded from northern Thailand: *L. roseophyllus*, *L. purpureus*, *Lactarius*, subgenus *Plinthogali* [Le et al. 2007a, b]. In India, *Lactarius* spp. are collected particularly in the Eastern Himalayas. *L. camphorates*, *L. piperatus*, *L. volemus*, *L. hygrophoroides* strongly dominate whereas *L. picinus*, *L. gerardii*, *L. deterrimus* are rare [Das and Sharma 2002]. In Nepal within *Lactarius* spp. can be found: *L. deliciosus*, *L. piperatu*, *Lactarius subpiperatus*, *L. thakalorum*, and *L. volemus* picking of this species took place in national forests, community-managed forests, religious forests, and on private land [Christensen et al. 2008]. *L. pyrogalus* is one of the most consumed *Lactarius* in provinces in the Middle Black Sea Region of Turkey [Peksen et al. 2008]. In turn, in the south-eastern Poland can be found: *L. picinus*, *L. piperatus*, *L. rufus*, *L. salmonicolor*, *L. scrobiculatus*, *L. vellereus*, and *L. volemus* [Chachuła 2016].

19.4.1. *Lactarius* spp. botany, occurrence and chemical composition

Lactarius is a genus of ectomycorrhizal macrofungi with an estimated 500 species around the globe. The genus *Lactarius* (Pers. ex S.F. Gray) belongs to the family *Russulaceae*. Ecologically more than 90% of *Lactarius* species belong to the group 'lignicolous' – growing on dead rotten woods. Caps and stipes may be almost white (*L. vellereus*), orange (*L. deliciosus*), or vividly colored (*L. scrobiculatus*, *L. rufus*) (Fig. 19.1). The flesh of a few species is mild and edible (e.g. *L. deliciosus*, *L. volemus*, *L. sanguifiuus*), while most *Lactarius* taste pungent or bitter, and ingestion causes irritation to intestinal walls [Daniewski and Vidari 1999]. Some species like *L. deliciosus*, *L. subdulcis*, *L. sanguifuus*, *L. hygrophoroides*, *L. volenus* are edible all over the world, while a few like *L. piperatus*, *L. helvus*, *L. torminus* are poisonous, but as we wrote in an earlier chapter in some countries they are edible. A characteristic feature of the *Lactarius* genus is the production of latex [Heilmann-Clausen 1998]. *Lactarius* spp. grow mainly in the Northern hemisphere, but also in smaller numbers in tropical countries. In turn, in the Southern hemisphere, there are only single endemic species, e.g. *L. clarkei* (Australia) and *L. stenophyllus* (Tasmania, Continental Australia) [McNabb 1971]. Poland is included in the Northern hemisphere countries and therefore *Lactarius* spp. occur in its territory. A special place of occurrence of *Lactarius* spp. are the areas of southern Poland, in particular the Carpathian region.


Photo: E. Bernaś

Fig. 19.1. *Lactarius* spp. form south-eastern Poland (around the town of Limanowa) own photography

In Poland, most of the edible species of mushrooms have their own polonized names, for example, 'borowik' or 'prawdziwek' for *Boletus edulis*, 'pieczarka' for *Agaricus* spp. In the most popular species from the *Lactarius* family – *Lactarius delicious* has the local name 'rydz', in English 'saffron milk'. In south-eastern Poland, unlike most of Poland, other species of *Lactarius* spp. are also consumed, which also have polonized, local names, like 'mleczaj biel', 'chrząszcz' or 'biel' for *L. vellereus*, 'krówka', 'mleczaj krówka' or 'mleczaj smaczny' for *L. volemus*, 'mleczaj późnojesienny' for *L. salmonicolor* [Wojewoda 2003, Referowska-Chodak 2015]. It should be emphasized that in recent years in Poland a decrease in the knowledge of children and youth about the collection of wild edible mushrooms has been observed. Most of them know what Boletaceae species look like and where to find them, while they have a problem with recognizing *Macrolepiota* spp., *Russula* spp., *Lactarius* spp. and wild-growing *Agaricus* spp. [Łuczaj and Nieroda 2011].

Bonet et al. [2012] showed that the way of forestry has an impact on the yield of *Lactarius deliciosus*. Cited authors have stated that the production was five times greater in plots in the first year after thinning and two times greater in the second year, as compared to the non-thinned plots. In addition, the thinning intensity and precipitation during August and September were the most significant factors explaining the annual yield of *Lactarius deliciosus*.

19.4.2. Chemical composition

Lactarius spp. are a source of many bioactive ingredients, and their level depends on, among others, the stage of ripeness of the fruiting bodies. They are rich in proteins, polysaccharides (chitin), and interesting bioactive sesquiterpenes present in the fruiting body. *Lactarius* spp. contains velutinal, stearovelutinal, velleral, izovelleral, furanodiol, lactarorufin A, and lactarorufin B [Marszałek et al. 2018]. Depending on the species, in 100 g of dry matter, they contain 15–25 g of protein, 1–7 g of fat, 1–13 g of ash, 15–38 g of total carbohydrates, and 30–42 g of crude fiber. The largest amount of ash and fat are found in *L. volemus*, proteins in *L. deliciosus*, and carbohydrates in *L. hatsudake*. In turn, in terms of the high level of amino acids, the *L. hygrophoroides* deserve attention [Peksen et al. 2008, Wang et al. 2014]. Among phenolic compounds, there are protocatechuic, sinapic, and cinnamic acids [Muszyńska et al. 2013]. In *L. deliciosus* and *L. piperatus* total phenols were the major bioactive components, ascorbic acid was found in small amounts (0.08–0.16 mg/g), and beta-carotene and lycopene were only found in vestigial amounts (< 49 μg/g). The highest contents of bioactive compounds were found for *L. piperatus* in stage II (mature with immature spores). For fruiting bodies without mature spores, the cap diameter was not correlated to the formation of bioactive compounds [Barros et al. 2007].

In *L. deliciosus* fat, oleic acid (41.3%) and stearic acid (25.3%) predominate, while palmitic (12.1%), linoleic (17.1%) and linolenic (0.3%) acid are found in smaller quantities. *L. deliciosus* contains significant amounts of mannitol (13.7% dry matter) and small amounts of glucose and trehalose. Of the polysaccharides, chitin is present in the largest amount, it can constitute up to 80–90% of dry matter. The basic sterol found in mushrooms is ergosterol [Kalac 2009, 2013].

19.4.3. Health promoting properties of *Lactarius* spp.

Edible mushrooms possess remarkable dietetic and medicinal values, including anticancer, immunostimulating (glucans, glycoproteins, sesquiterpenes, triterpenoids), antiatherosclerotic properties (chitin, chitosans, statins), antibacterial and antifungal action (antibiotics) and antioxidant potential (sterols, tocopherols, flavonoids, carotenoids, indole compounds, and phenolic compounds) [Wasser and Weis 1999, Cheung 2008]. *Lactarius* spp. are also a source of bioactive ingredients. Agrawal and Dhanasekaran [2019] report that lectins extracted from them have anticancer activity. *L. flavidulus* polysaccharide efficiently inhibits the growth of Sarcoma 180, even up to 100%. Another study shows that *L. deliciosus* polysaccharide (LDG-A) exhibited significant anti-tumor activates in vivo and may be one ideal source of antitumor development [Ding et al. 2012]. *Lactarius* spp. are rich sources of natural antibiotics, and therefore mushrooms extracts have antimicrobial activity. *L. deliciosus* contains azulens (lactarioviolin and lactarazulen) with antibacterial actions [Stamets 2002]. Dulger et. al. [2002] have found that *L. species*, *L. deterrimus*, *L. sanguifluus*, *L. semisanguifluus*, *L. piperatus*, *L. deliciosu*s, and *L. salmonicolor* fruiting bodies revealed antimicrobial activity against some Gram (+) and Gram (–) bacteria, but showed no antagonistic effect against yeasts. The greatest inhibition was observed for *Escherichia coli*, *Proteus vulgaris*, and *Mycobacterium smegmatis*.

19.5. Summary

Mushrooms grown played an important role in the lives of residents of south-eastern Poland. They were not only a source of food but also were used in medicine, household, and religious rites. Today, the vast majority of applications, commonly known in the past, ceased to be relevant, because it has been superseded by modern technologies and forgotten. Mushroom picking and preservation is treated as a hobby, which, due to the preservation of the cultural heritage of the region, is a worrying phenomenon.

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The project is based on the concept of cultural heritage of "small homelands" – the heritage that has survived in original animals species, plants species, and landscape to this day, and that constitutes a unique wealth and value. The project's main objective is to describe cultural heritage preserved in small local communities, as illustrated by the example of the Małopolska region. Another task of the project is to find, describe, and possibly evaluate similar small, particular ecosystems in Europe and the world.

The project website: https://foodheritage.urk.edu.pl

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