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Article *in* Genetic Resources and Crop Evolution · January 2019

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RESEARCH ARTICLE

Ethnobotanical study and traditional use of autochthonous pear varieties (*Pyrus communis* L.) in southwest Serbia (Polimlje)

Aleksandra Savić · Snežana Jarić · Zora Dajić-Stevanović · Sonja Duletić-Laušević

Received: 18 May 2018 / Accepted: 17 December 2018

Abstract This work represents an ethnobotanical and ethnomedicinal study focused on recording autochthonous pear varieties of the Polimlje region in southwest Serbia. The purpose of the study was to highlight genetic resources of pear varieties in situ and emphasize aspects of ethnodiversity and traditional knowledge. A special feature of the research area is the great diversity of indigenous varieties of pear, which have been cultivated for hundreds of years. Forty-six respondents from 25 to 78 years of age residing in 23 villages were interviewed, and 26 autochthonous pear varieties were recorded in the field. Among them 11.5% are widely available, 26.9% are rare, and 61.5% are very rare. For ethnomedicinal purposes, pear is used as a remedy against hypertension, diabetes, high cholesterol, and constipation; for reduction of body mass; as a uroseptic and/or an antirheumatic; and for cancer prevention. Pears are consumed as fresh fruit and in numerous food products. Depopulation of the investigated rural area is directly responsible for depletion of the gene pool of pear varieties and for loss of traditional knowledge. Preservation can be achieved by in situ methods such as raising awareness of the local inhabitants and ensuring support of the State.

Keywords Diversity of pear varieties · Ethnobotany · Ethnomedicine · Traditional knowledge

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Introduction

The Balkan Peninsula is one of the world's centers of biodiversity (Myers et al. 2000). Characterized by a remarkable richness of medicinal plants (Jarić et al. 2007, 2015) and high agrobiodiversity (Vasić et al. 2013), it is home to a large number of fruit varieties, which have been traditionally utilized by the local population (Dajić-Stevanović et al. 2014). The flora includes crops with a large number of autochthonous varieties, and this diversity represents a unique genetic resource (Haas 2012). The Balkan region in recent years has been the focus of several ethnobotanical studies (Pieroni et al. 2011; Menković et al. 2011;

Published online: 30 January 2019

Šarić- Kundalić et al. 2010, 2011; Mustafa et al. 2012a, b; Šavikin et al. 2013; Zlatković et al. 2014; Jarić et al., 2007, 2014, 2015; Dajić-Stevanović et al. 2014; Savić 2014, 2016). These studies focused on a specific section of the region's biocultural heritage, uses of plants, food, and goods in folk medicine, in the human diet, and in the preparation of different local products (Dajić-Stevanović et al. 2014).

Pear (*Pyrus* L.) is a fruit tree from Eurasia that originated in the Tertiary, and its range gradually spread both east and westward. It has been in Europe for over 3000 years (Wolko et al. 2010). The fruit is widely accepted for its crispness, sweetness, aroma, and characteristic fragrance, and numerous products are prepared with it: juice, jam, candy, preserved fruits, beverages, food for babies, and dietary food (Parle and Arzoo 2016). Pears contain health-promoting and medicinally beneficial constituents, such as vitamins—(especially ascorbic acid), carotenoids, volatiles, sugars, organic acids, and fibres (Reiland and Slavin 2015; Parle and Arzoo 2016); minerals (Mahammad et al. 2010); polyphenols and flavonoids (Carbonaro et al. 2002; Salta et al. 2010; Li et al. 2016; Parle and Arzoo 2016); and anthocyanins, triterpenes, amino acids, and other nutrients (Imeh and Khokhar 2002; Kaur and Arya 2012). In China, pears have been used as a traditional folk remedy for more than 2000 years, and they were also used as such in ancient Greece (Li et al. 2012; Reiland and Slavin 2015). Each part of the pear tree has multiple medicinal uses including antioxidant, hypoglucaemic, antiinflammatory, antipyretic, sedative, analgesic, hypolipidemic, wound healing, antimicrobial, and hepatoprotective properties (Parle and Arzoo 2016). In some studies, pear fruit was linked to less frequent occurrence of type 2 diabetes and stroke (Guo et al. 2017) or was shown to prevent uterine cancer, especially in menopausal women (Parle and Arzoo 2016).

Fruit production in Serbia was traditional until the 1930s, with the cultivation of indigenous pear varieties from the 19th century and before. Pear farming in Serbia has now been intensified, and new pear varieties threaten the survival of indigenous varieties (Savić 2016). The production of pears in Serbia is in decline (63,843 t in 2016), and pears on the market are imported from Argentina, Turkey, Chile, and Italy (http://webrzs.stat.gov.rs/WebSite/Public/ReportResultView.).

The Polimlje region in southwest Serbia is a unique multiethnic complex of architectural, cultural, and natural diversity. A special feature of Polimlje is the great diversity of indigenous pear varieties, which is a result of farming for hundreds of years (Savić 2014).

In this research, we conducted an ethnobotanical study to highlight the biological diversity of pear varieties in situ and protect their traditional identity in southwest Serbia. The aims of the study were to: (1) document the diversity of indigenous pear varieties most common in southwest Serbia; (2) determine their distribution and methods of farming within the research area; (3) examine traditional use of pears in ethnomedicine; and (4) document traditional knowledge about the preparation of domestic products, processing of pear fruit, and ways in which it is used.

The study should contribute to the conservation of autochthonous pear fruit varieties in situ for potential use in future hybridization programs, as well as to the conservation of agrobiodiversity in general.

Materials and methods

Study area

The Polimlje region (43° 19′ N, 19° 39′ E, and 43° 35′ N, 19° 31′ E) in southwest Serbia borders Montenegro and Bosnia and Herzegovina (Figs. 1 and 2). The largest percentage of this territory—a total f 3 o 3.6%—is above 500 m a.s.l. (above sea level) and 53.7% of that is at elevations from 1000 to 1500 m a.s.l. Most fruit grows below 1000 m a.s.l. on about 35% of the territory. The mix of continental and Mediterranean air masses makes a climate suitable for pear farming. The summers are warm (average 19.1 °C, max 34 °C), while the winters are cold (average − 2,8 °C) with frequent snowfall from October to May. The average rainfall is about 789.5 mm/m^2, while the average annual temperature is 9.3 °C. At lower altitudes the climate is mild, while at higher altitudes (above 1500 m a.s.l.) it is of a mountain type. Limiting climatic factors for pear production in Polimlje are the longevity of snow cover in the spring and the appearance of hoarfrost during the flowering period (Pavlović et al. 2009).

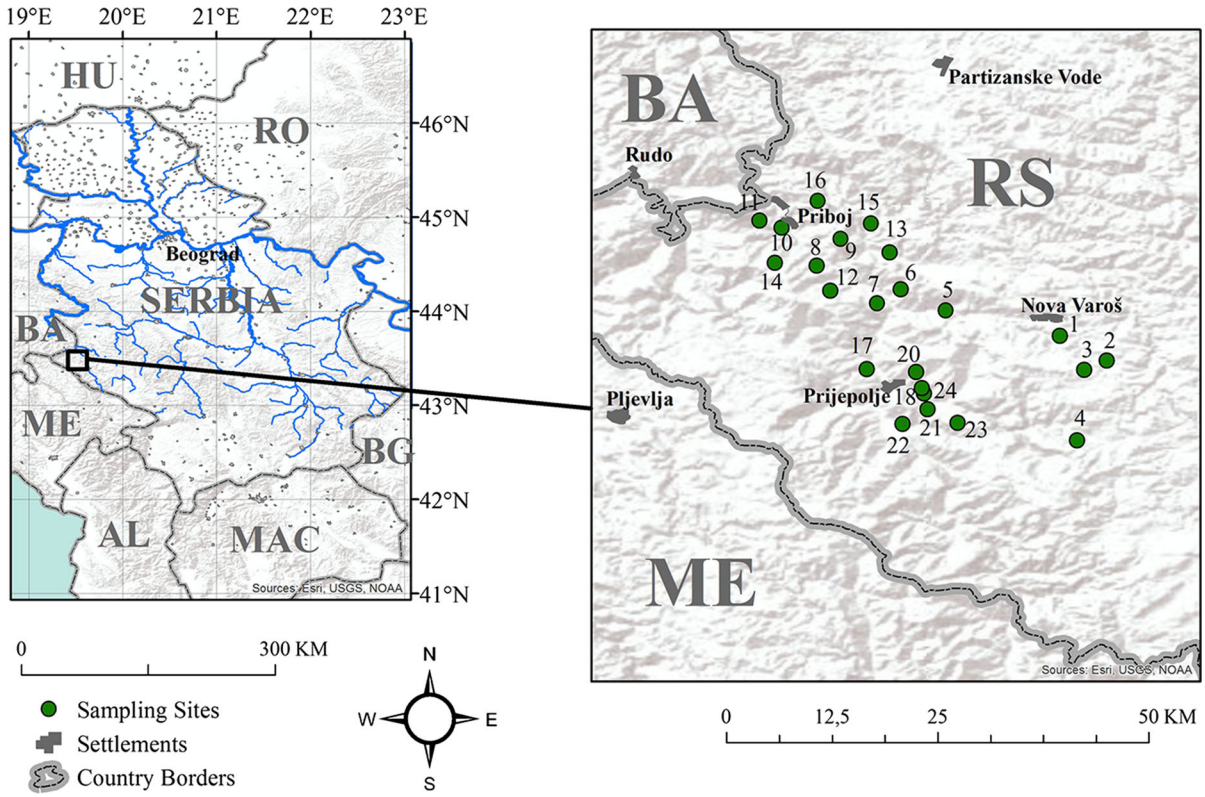

Fig. 1 Study sites and their geographical location. Villages: 1. Brdo, 2. Akmadžići, 3. Drmanovići, 4. Aljinovići, 5. Bistrica, 6. Pribojske čelice, 7. Kučin, 8. Kalafati, 9. Pribojska Banja, 10. Čitluk, 11. Crnuzi, 12. Mažići, 13. Kratovo, 14. Dobrilovići, 15. Jelača, 16. Rača, 17. Zalug, 18. Peseljak, 19. Rasno, 20. Mileševo, 21. Ivanje, 22. Hisardžik, 23. Taševo

Study site and population

The research was carried out on the territory of 23 villages in three municipalities (100 sq. km), viz., Priboj, Prijepolje, and Nova Varoš (Fig. 1), which are situated at different elevations (600–1500 m a.s.l.). These villages are relatively small in terms of population, and are located in the proximity of main and secondary roads. Many of the houses are used only for holidays and are not permanently occupied.

In all of the visited villages, people under the age of 30 were in the minority due to their migration to nearby towns. The population is multiethnic with approximately 73,000 inhabitants. According to the census of 2011, there are 61% Serbs, 34% Bosniaks (Slavic Muslims), and 5% members of other ethnic groups (Premović 2013). The official language is Serbian.

Ethnobiological research, collection and analysis of data

Ethnobotanical research was carried out in the study area during June to October of 2015–2017. Open and semi-structured interviews (Weckerle et al. 2018) were conducted with 46 people (34 men and 12 women; Table 1), 75% of whom were between 55 and 78 years old, 22% between 30 and 50 years old, and 3% between 25 and 30 years old. All of the participants were born or have lived in this area at least 25 years. Each interview took approximately 60–90 min. The persons interviewed were predominantly engaged in agriculture (older participants), while some were employed in other occupations (sales, truck driving, teaching, etc.). In each village, we selected available households with residents who were willing to converse, who had an orchard, and who possessed traditional knowledge as well.

In the course of the interview, participants were asked to name all the pear varieties they know and

Fig. 2 The Polimlje region (along the river Lim)

grow, explain how those varieties came to be present in the study area, and describe the growing methods and agrotechnological measures used to obtain a better yield. Also, an important part of the questionnaire pertained to the sale of pears at local markets and proposals of adequate measures ensuring their preservation for future generations. Additionally, data were collected in the field (based on the experience of the informants) about diseases and pests resistance of the pear varieties present in the study area, the extent of their presence in it, and traditional use of pears in nutrition. A special part of the questionnaire was devoted to the use of pear varieties in ethnomedicine, i.e., how they are used to deal with certain health problems. From the respondents we obtained data about the plant parts used, methods of preparation, and ways of administration.

Specimens were collected and deposited in the herbarium of the Museum of Natural History in Belgrade (BEO 582.634.1). The available fruits of pear varieties were photographed and/or drawn by hand, and the conversations with participants were recorded.

The data collected during the field study were sorted in Microsoft Excel. We calculated the use value (Trotter and Logan, 1986) according to the formula UV = U/N, where UV is use value, U is the number of citations per variety, and N is the number of informants.

Results and discussion

Methods of farming pear varieties

The methods of farming pear varieties based on the respondents' answers are described in Table 2. Pear varieties in the study area grow almost exclusively as single trees (82.6%) and plantations do not exist. Most of the pear varieties were inherited from ancestors, which indicates that traditional farming is passed on through generations. Some varieties also came from grafting, from neighbours, or from another village. For many varieties, the hosts do not know how their ancestors acquired them—"they had simply always been there". There is awareness that many varieties are rare and some residents want to renew them. It was mostly the case that elderly people live in the approached households and there is no one to farm pears (82.6%), but sometimes the property was completely neglected (28.2%). Chemical protection of these trees is not used (41.3%), or else is used very rarely (26%). Occasionally, the population brings pears to the local market for sale, but many fruits remain unused and decay, or are used as food for livestock. Many customers buy old pear varieties as organic farming products or for emotional reasons, because they remind them of their childhood.

Table 1 Age and sex of participants

Participants	25–30 years	30–55 years	55–78 years	Total	%
Men	2	10	22	34	73.9
Women	0	2	10	12	26.1

Table 2 Questionnaire: method of farming pear cultivars based on respondents' answers

Questions	Offered answers	Frequency of mentioning
Do you grow fruit?	Growing fruit is an integral part of life in the country, whether it is commercial or not.	35/46 (76%)
	We grow everything we are able to	
	It is part of the tradition. It is customary to have numerous fruit varieties either in the yard or orchard. There are plenty of wild fruits (walnuts, chestnuts), but we planted or grafted numerous fruit varieties by ourselves	40/46 (86.9%)
	I grow the fruits that are traditional for this region: apple, pear, plum, walnut, quince, red cherry, cherry, etc	38/46 (82.6%)
	I don't grow fruit on a large scale, only for personal use	20/46 (43.5%)
	I have only got several trees in my backyard	15/46 (32.6%)
	I only grow what I inherited	13/46 (28.2%)
	I inherited	41/46 (89.1%)
How did you acquire the local varieties of pears?	When I got married, they were there (women)	9/46 (19.5%)
	My grandfather grafted the variety, he went to some other village to acquire the graft because he had heard that the variety was of high quality	21/46 (45.6%)
	My neighbour gave me the graft	14/46 (30.4%)
	I know nothing about the origin of that tree, it has always been in the backyard	18/46 (39.1%)
	I had to cut the tree down, it was very old, but I grafted it to a young stem in order to preserve the variety	9/46 (19.5%)
	The tree had dried up and I had to cut it down, so now I can no longer find this variety anywhere	12/46 (26%)
Do you grow fruit in plantations or just as individual trees?	I grow pears only as individual trees	38/46 (82.6%)
	I can't afford a plantation, my estate is completely unkempt	13/46 (28.2%)
	There is no one to process the orchard, I am old	38/46 (82.6%)
	The young have left and don't want to return to the village, there is no one to deal with the fruit	22/46 (47.8%)
	I only grow for personal needs	40/46 (86.9%)
	Even when we don't eat fruit, I like to have a pear tree in the backyard	41/46 (89.1%)
Do you use any chemical protection?	I don't use any chemical protection	40/46 (86.9%)
	I use basic protection in very small quantities during spring and summer, and one month before picking the fruit I stop spraying completely	12/46 (26.9%)
	I use chemical protection occasionally	9/46 (19.5%)
Do you use any agrotechnical measures?	In the beginning, I pruned the trees while they were young and had a lower crown, but now I let them grow naturally	19/46 (41.3%)
	I do but very little	12/46 (26%)
	I don't, those trees are very old and wild and I see no point in using them	15/46 (32.6%)

Table 2 continued

Questions	Offered answers	Frequency of mentioning
What is the quality of old pear varieties that you grow?	Numerous varieties are of high quality and long-lasting, and they can be used throughout winter to spring	22/46 (47.8%)
	Early, summer varieties decay, they are full of water, and are not very sweet	15/46 (32.6%)
	Many varieties are very good, but they are endangered and may disappear completely	39/46 (84.7%)
	I keep some pears in the cold in straw until spring, they are very good	19/46 (41.3%)
Do you sell pears in the market?	Sometimes I do, as many as I can pick.	25/46 (54.3%)
	I never do, although the trees bear fruit in abundance.	31/46 (67.4%)
	They rot or I make something or feed them to livestock	
Do people in the market buy local pear varieties?	There are people who only buy those old varieties for sentimental reasons because they remind them of childhood, parents, ancestors, or they just love the taste	12/46 (26%)
	People buy these local varieties because they know I don't use any chemical protection.	25/46 (54.4%)
	They buy in small quantities and use fresh fruits	13/46 (28.2%)
	Sometimes they buy to make home-made juice or jam for the children	8/46 (17.4%)
How much can be earned by selling pears in the market?	Old varieties are usually much more expensive than the new ones.	28/46 (60.8%)
	They are rare and are sold in smaller quantities, and the customers know they are organic	
	I earn enough to buy basic food supplies for a week	18/46 (39.1%)
	I can't earn a lot, but any income is welcome	22/46 (47.8%)
Besides food, do these pear varieties have any other significance for you?	They are significant for tradition and family customs	40/46 (86.9%)
	We have good memories of a pear tree in the backyard, of us sitting and talking in its shade	24/46 (52.2%)
	My grandparents or parents taught me to make brandy, jam, cakes, or juice.	38/46 (82.6%)
	That knowledge is passed on through generations	
	The tree is very good for making wooden objects	13/46 (28.2%)
In your opinion, what kind of future do these local pear varieties have and what needs to be done to preserve them?	Old pear varieties vanish, they are kept sporadically, and their survival in the next 50 years is hard to predict	41/46 (89.1%)
	Households that cultivate these varieties are mostly with one or two members, these are very old people, and when they are gone, the house will remain empty	34/46 (73.9%)
	The young are not interested in preservation of these varieties, they leave for the cities	31/46 (67.4%)
	It is necessary for the State to make a plan for preservation of these varieties, by providing financial assistance to the households	38/46 (82.6%)

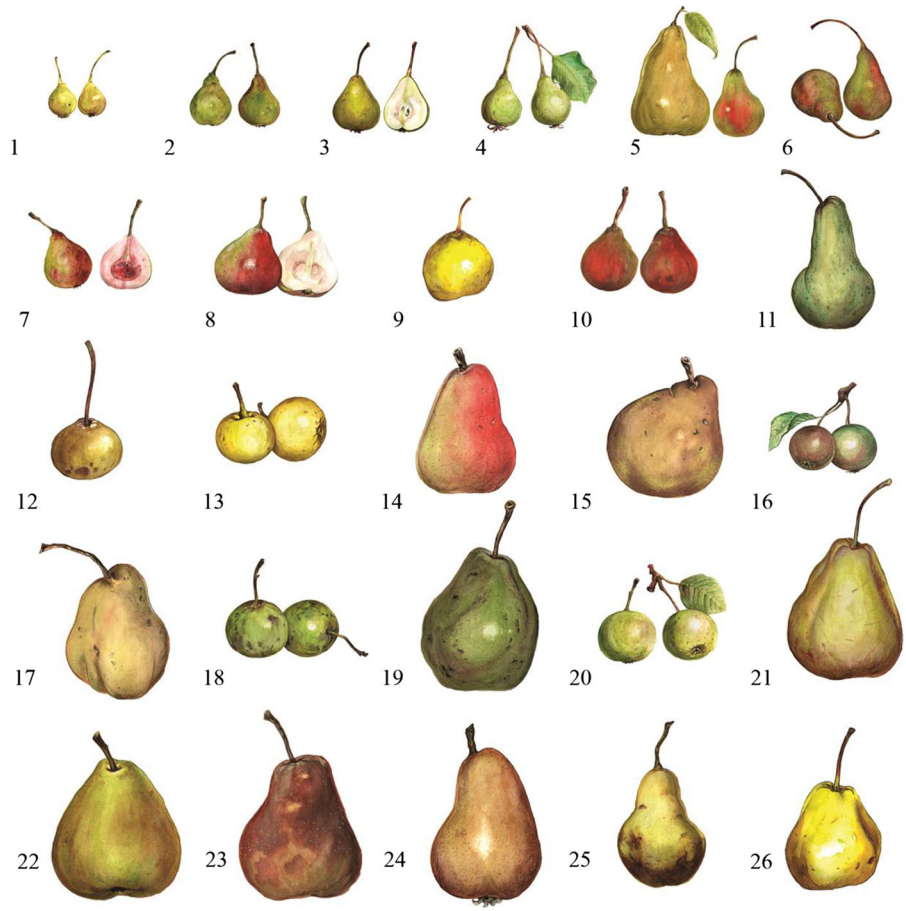

Fig. 3 Collected pear fruit varieties: 1. Jagodarka, 2. Vidovača, 3. Ječmenjača, 4. Petrovka, 5. Ilinjača, 6. Mirisavka, 7. Lubeničarka, 8. Sijerak, 9. Turundžija, 10. Medunak, 11. Stambolka, 12. Čađavica, 13. Okruglica, 14. Mesnjača, 15. Jarac, 16. Takiša, 17. Karamanka, 18. Bazva, 19. Jeribasma, 20. Tepavac, 21. Zimnjača, 22 Lončara, 23. Kantaruša, 24. Ovčara, 25. Turšijara, 26. Budaljača

Diversity of Pyrus varieties

Our ethnobotanical study established the presence of 26 pear varieties (Fig. 3, Table 3). There are situations where the same variety has synonyms in different areas of the Balkans (*Karamanka* pear is also called *Babovača, Bundovanka,* or *Bazduhanlija*; *Lubeničarka* pear is sometimes called *Bostanjača*; *Jeribasma* pear is also called *Vodenjak* or *Pljuskača*; and *Ječmenjača* pear is sometimes called *Pšeničarka*) (Beširević 2009; Savić 2016). With respect to their origin, the vernacular names are derived from the Serbian or Turkish language.

Pears are named according to various criteria: the time of ripening (*Jagodarka* pear—early ripening in the season of strawberries, *Petrovača*—ripening at St. Peter's Day, *Ječmenjača* pear—ripening when barley is ripe, *Ilinjača* pear—ripening at St. Elijah's Day, *Vidovača* pear—ripening at St. Vitus' Day, *Zimnjača* pear—winter pear); the locality where the variety was first recorded or from which it originated (*Karamanka* pear—from the Karaman area in Asia Minor, *Stambolka* pear—from the city of Istanbul); or characteristics of the fruit—shape, taste, smell, colour, consistency (*Mirisavka* pear—nicely fragrant, *Okruglica*—rounded fruit, *Medunak*—honey taste, *Čađavica*—ashy, *Turšijara*—sour, pickle pot) (Savić 2014, 2016).

Table 3 presents different pear varieties from Polimlje according to the ripening period from May to October. Similar studies have shown that some of the pear varieties are also disseminated in Bosnia and Herzegovina (Beširević 2009; Gasi et al. 2013), northern Montenegro (Mratinić 2000; Pieroni et al. 2011), western Macedonia (Selamovska et al. 2015), and different parts of Serbia and other Balkan countries (Dajić-Stevanović et al. 2014).

Characterization and identification of pear cultivars was performed according to morphological traits of the fruit. In terms of origin, 21 varieties from Polimlje

Table 3 *Pyrus communis* L. varieties found in the region of Polimlje, Serbia

Vernacular name	Meaning	Locality	Origin	Ripening period	Tree characteristics	Fruit characteristics	Resistance to diseases and pests	Fruit duration	Degree of presence	Traditional use in nutrition
1. Jagodarka Rančica	Strawberry	Prijepolje	Unknown	May–June	Well-developed crown Long-lived Good crop yield	Very small elongated fruit (20-50 per kg) Greenish-yellow skin Pedicel medium White flesh Medium sweet, soft Pleasant aroma and taste	++	+	+	Consumption
2. Vidovača	St. Vitus Day	Prijepolje Priboj	Unknown	Late June	Medium-sized pyramidal crown Good crop yield	Small fruit Greenish-yellow skin Spinning-top shape Pedicel medium Long narrow stem White flesh Soft, juicy, sweet Pleasant aroma	++	+	++	Consumption
3. Ječmenjača Ječmenka	Barley pear	Prijepolje Priboj	Considered to be from the Czech Republic	June–July	Well-developed crown Long-lived Good crop yield	Small, rounded fruit Greenish-yellow skin Pedicel medium Greenish white Flesh medium sweet, dry Numerous stone cells	+++	+	++	Consumption
4. Petrovka Petrovčica	St. Peter's Day	Prijepolje Priboj Nova Varoš	Unknown	Early July	Well-developed crown Long-lived Good crop yield Demanding warmer conditions	Small to medium fruit Pear-shaped Light green skin Pedicel elongated Greenish-white flesh Juicy, tasty Without a special aroma	++	+	+++	Consumption

Table 3 continued

Vernacular name	Meaning	Locality	Origin	Ripening period	Tree characteristics	Fruit characteristics	Resistance to diseases and pests	Fruit duration	Degree of presence	Traditional use in nutrition
5. Ilinjača	St. Elijah's Day	Prijepolje Priboj Nova Varoš	Unknown	Mid July	Medium-sized luxuriant pyramidal crown Good crop yield	There are two forms of this variety: large and small fruit Greenish-yellow skin Pedicel short to medium White flesh Medium sweet and melting Without stone cells	++	+	++	Consumption
6. Mirisavka Mirisavac	Fragrant	Prijepolje	Unknown	Late July	Medium-sized luxuriant thick crown Good crop yield	Medium-small fruit Greenish yellow skin Pedicel elongated White flesh Medium sweet and melting Without stone cells Special characteristic aroma	+++	++	+	Consumption Jam Pekmez Baby food Pies Juice Compote Brandy
7. Lubeničarka Bostanjača	Watermelon	Prijepolje Priboj	Unknown	July–August	Medium-sized luxuriant pyramidal crown Good crop yield Resistant to frost	Medium small fruit Greenish-yellow- red skin Pedicel medium Characteristic red colour of flesh Sweet-acidic flesh Characteristic watermelon flavour	+++	+	++	Consumption

Table 3 continued

Vernacular name	Meaning	Locality	Origin	Ripening period	Tree characteristics	Fruit characteristics	Resistance to diseases and pests	Fruit duration	Degree of presence	Traditional use in nutrition
8. Sijerak Sijerkovača	/	Prijepolje Priboj	Unknown	Mid July	Luxuriant well-developed crown Good crop yield	Medium-sized elongated fruit Pear-shaped, glossy greenish-ruddy skin Pedicel medium Sweet tasting Pleasant aroma Melting and juicy Without stone cells	++	+	+	Consumption Jam Pekmez Baby food Pies Juice Brandy
9.Turundžija	/	Prijepolje	Unknown	Late July	Luxuriant well-developed crown Resistant to frost and drought	Small fruit Yellow skin Pedicel medium White flesh Soft Pleasant aroma	+++	++	+	Consumption Jam Pekmez Baby food Pies Juice Compote Brandy
10. Medunak Mednik Mednjak	Honey pot	Prijepolje Priboj	Unknown	July–August	Well-developed large pyramidal crown Good crop yield	Medium-sized to large fruit Smooth shiny skin greenish-yellow with additional reddish tinge Pedicel of medium length Yellow, large-grained flesh Melting Sweet “like honey”	++	++	++	Consumption Jam Pekmez Baby food Pies Juice Compote As dried fruit Brandy

Table 3 continued

Vernacular name	Meaning	Locality	Origin	Ripening period	Tree characteristics	Fruit characteristics	Resistance to diseases and pests	Fruit duration	Degree of presence	Traditional use in nutrition
11. Stambolka	Istanbul pear	Prijepolje	Middle East	July–August	Medium-developed crown, long-lived Good crop yield Demands fertile soil with good aeration	Medium-sized fruit Greenish-yellow skin Pedicel elongated Juicy, sweet, melting flesh Musky aroma	+++	+++	+	Consumption Jam Pekmez Baby food Pies Juice Compote As dried fruit Brandy
12. Čađavica	Ashy	Prijepolje	Unknown	July–August	Well-developed crown Long-lived Good crop yield	Small fruit Greenish-yellow skin Pedicel elongated Dry, soft flesh Sweet Pleasant aroma	++	+	+	Consumption As dried fruit Brandy
13. Okruglica	Ball-shaped	Prijepolje	Unknown	August	Medium-developed crown Long-lived Good crop yield	Medium-sized Round shape Pedicel of short length Greenish-yellow in colour Waxy skin Smooth white flesh Medium sweet, not juicy Without stone cells	+++	++	+	Consumption Jam Pekmez Baby food Pies Juice Compote As dried fruit Brandy

Table 3 continued

Vernacular name	Meaning	Locality	Origin	Ripening period	Tree characteristics	Fruit characteristics	Resistance to diseases and pests	Fruit duration	Degree of presence	Traditional use in nutrition
14. Mesnjača	Meat-like	Prijepolje	Unknown	August	Medium-developed crown Long-lived Good crop yield Resistant to frost and drought	Small to medium- sized fruit Rounded pear shape Rough, greenish- brown skin Pedicel of short length, thickened White flesh Medium sweet Crunchy, with numerous stone cells	+++	++	+	Consumption Jam Pekmez Baby food Pies Juice Compote Slatko As dried fruit Brandy
15. Jarac	Billy goat	Prijepolje	Middle East	July–August	Medium-developed crown Long- lived Good crop yield	Medium-sized fruit Pear-shaped Thin yellowish skin Pedicel of short length, thickened White flesh Melting, sweetly-acidic, juicy Pleasant aroma	+++	++	+	Consumption Jam, pekmez Baby food Pies Juice Compote Slatko As dried fruit Brandy
16. Takiša Takuša	/	Prijepolje	Unknown	September	Luxuriant, healthy, long-lived Large cauldron-shaped crown High crop yield (up to 1000 kg per season)	Very small fruit Rough yellowish-brown skin Pedicel of medium length Dry, soft flesh Medium sweet, dry Numerous stone cells Astringent taste	+++	++	++	Consumption Compote As dried fruit Brandy Vodnjika

Table 3 continued

Vernacular name	Meaning	Locality	Origin	Ripening period	Tree characteristics	Fruit characteristics	Resistance to diseases and pests	Fruit duration	Degree of presence	Traditional use in nutrition
17. Karamanka Babovača Bundovanka Bazduhanlija	Karaman pear	Prijepolje Priboj Nova Varoš	Asia Minor – Karaman region	August–September	Healthy, long-lived Crown with rare branches facing the ground Medium crop yield	Medium-sized fruit Pear-shaped, asymmetrical with characteristic pronounced bumps Pedicel elongated Yellowish, melting, juicy, sweet flesh Characteristic musky smell	+	++	+++	Consumption Jam Pekmez Baby food Pies Juice Compote Slatko Sita As dried fruit Brandy
18. Bazva Batva	/	Prijepolje	Unknown	August–September	Luxuriant, healthy, long-lived Large cauldron-shaped crown High crop yield	Small fruit Round shape—resembling an apple Yellowish-brown skin Thick and rough skin Pedicel of medium length Spongy, soft flesh Sweet, acidic in taste Refreshing aroma	+++	++	+	Consumption Compote As dried fruit Brandy Vodnjika
19. Jeribasma Vodenjaca Pljuskaca	Watery	Prijepolje Priboj	Middle East	September–October	Healthy Long-lived (up to 200 years) High crop yield (up to 2000 kg per season)	Meduim-sized to large fruit Pear-shaped—asymmetrical Thin yellowish skin Pedicel of medium length, thickened White acidic-sweet flesh Extremely juicy flesh Numerous stone cells	+++.	++	+++	Consumption Jam Pekmez Baby food Pies Juice Compote Brandy Vodnjika

Table 3 continued

Vernacular name	Meaning	Locality	Origin	Ripening period	Tree characteristics	Fruit characteristics	Resistance to diseases and pests	Fruit duration	Degree of presence	Traditional use in nutrition
20. Tepavac	/	Prijepolje	Unknown	September–October	Luxuriant Large crown (up to 20 m) Long-lived (up to 150 years) High crop yield	Medium-sized fruit Round in shape Olive-green skin Pedicel of short to medium length Tough flesh—after some time it becomes soft and sweet Numerous stone cells	++	++	+	Consumption Brandy As dried fruit Vodnjika
21. Zimnjača	Winter pear	Prijepolje Priboj Nova Varoš	Unknown	October	Middle-sized crown Long-lived High crop yield	Very large (up to 300 g) pear-shaped fruit Yellowish brown Thick rough skin Pedicel elongated White, tough flesh Astringent taste Not too sweet Numerous stone cells (resembling a quince)	++	+++	++	Consumption Jam Pekmez Compote As dried fruit Brandy Turšija preserved in jar
22. Lončara	Pot belly	Prijepolje Priboj	Unknown	October	Middle–sized crown Long-lived High crop yield	Very large (up to 300 g) pear-shaped fruit Yellowish green skin Thick rough skin Pedicel of short length, thickened White tough flesh Astringent taste Numerous stone cells In the overripe phase the flesh becomes juicy, sweet, and slightly aromatic	++	+++	+	Consumption Jam Pekmez Baby food Pies Juice Compote Slatko As dried fruit Brandy

Table 3 continued

Vernacular name	Meaning	Locality	Origin	Ripening period	Tree characteristics	Fruit characteristics	Resistance to diseases and pests	Fruit duration	Degree of presence	Traditional use in nutrition
23. Kantaruša	Balance for weighing	Prijepolje	unknown	October	Middle–sized cauldron-shaped crown Long-lived tree High crop yield Thrives best in places protected from wind	Very large fruit (300 - 400 g) Elongated—ovate shape Yellowish-green skin covered in rusty film Pedicel of medium length White tough flesh Astringent taste Numerous stone cells	++	+++	+	Consumption Jam Pekmez Baby food Pies Juice Compote Slatko As dried fruit Brandy
24. Ovčara	Sheep's head	Prijepolje	Unknown	October	Middle-sized crown Long–lived tree High crop yield	Medium-sized pear-shaped fruit Thick yellowish skin Pedicel of short length, thickened Tasty, juicy, and sweet flesh	++	+++	+	Consumption Jam Pekmez Baby food Pies Juice Compote Slatko As dried fruit Brandy
25. Turšijara	Pickle pot	Prijepolje	Unknown	October	Luxuriant, healthy, long-lived Large crown High crop yield Resistant to frost	Small to medium-sized fruit Oval shaped Smooth and shiny greenish skin Pedicel elongated White, tough flesh Astringent taste Numerous stone cells	+++	+++	+	Consumption Vodnjika Turšija—preserved in jar

Table 3 continued

Vernacular name	Meaning	Locality	Origin	Ripening period	Tree characteristics	Fruit characteristics	Resistance to diseases and pests	Fruit duration	Degree of presence	Traditional use in nutrition
26. Budaljača	Foolish	Prijepolje	Unknown	October	Luxuriant, healthy, long-lived	Very large fruit (up to 300 g) with brownish thick skin	+++	++	+	Consumption
					Large pyramidal crown	Pedicel of medium to long length				Jam
					High crop yield	Medium-sweet flesh				Juice
						Numerous stone cells				Brandy
						Without aroma				

Resistance to diseases and pests: Resistant +++, Medium resistant ++, Not resistant+

Fruit duration: Very long +++, Medium long ++, Fast rot+

Presence: Present +++, Rare ++, Very rare—almost disappeared +

(80.8%) are with unknown origin; four varieties (15.4%) are considered to have originated from the Middle East and Asia Minor; and one variety (4.2%), *Ječmenjača* (*Ovesnicka* in Czech), is believed to have originated from the Czech Republic (Fig. 4a). As for resistance to diseases and pests (pear scab caused by *Venturia pirina,* fire blight caused by *Erwinia amylovora,* pear sawfly—*Hoplocampa brevis,* and pear fruit moth—*Carpocapsa pyrivora*), the experience of local growers indicates that 50% of varieties are very resistant, 46.2% are resistant, and only 3.8% are not resistant (Fig. 4b).

Many pear varieties in the study area remain on the grounds of old and abandoned homes, on rugged terrain, in villages without any road, and on mountain slopes. It is typical that the trees of pear varieties, although long-lived, are very old, in poor condition, and close to their biological death, and it is necessary to graft them onto young wild pear trees. Based on the interviews with respondents, many trees were over 80 years old. Investigated varieties derived from the same ancestor, *P. communis* L. according to the studies conducted in the neighbourhood area (Gasi et al. 2013; Dajić-Stevanović et al. 2014; Selamovska et al. 2015; Mratinić 2000).

In the present study, participants noticed that the fruits of many early summer varieties of pear (30.7%) quickly decay after maturation. Summer and autumn varieties (46.3%) have medium fruit durability, while winter varieties (23%) are more permanent and can be preserved throughout the winter until spring (Fig. 4c).

According to the respondents' answers and frequency of mentioning, 11.5% of these varieties are present in yards, 26.9% are rare, and 61.5% are extremely rare (Fig. 4d). Besides the described varieties, in the interviews we recorded the names of some traditional pear varieties that were not found in yards but were mentioned in conversations with older participants, which were also confirmed by different authors (Mratinić 2000; Beširević 2009; Savić 2016), indicating that they are missing or extremely rare. These are: *Arpadžik, Žuta šećerka, Ramaganlija, Begovača, Dervišica, Stranjanka, Musćija, Tropa, Kolačuša, Žutka, Lisica, Lisičarka, Mileševka, Dolakinja, Jendžirica, Budala, Šementlija, Žuta ranica, Tvrda ranica, Kiseljača, Sipavac, Maslik, Sarajka, Tvrdognila, Čokića divljaka, Derviška, Rskavac, Carevatva,* and *Buzdohanica*. They have unusual vernacular names which are related to characteristics

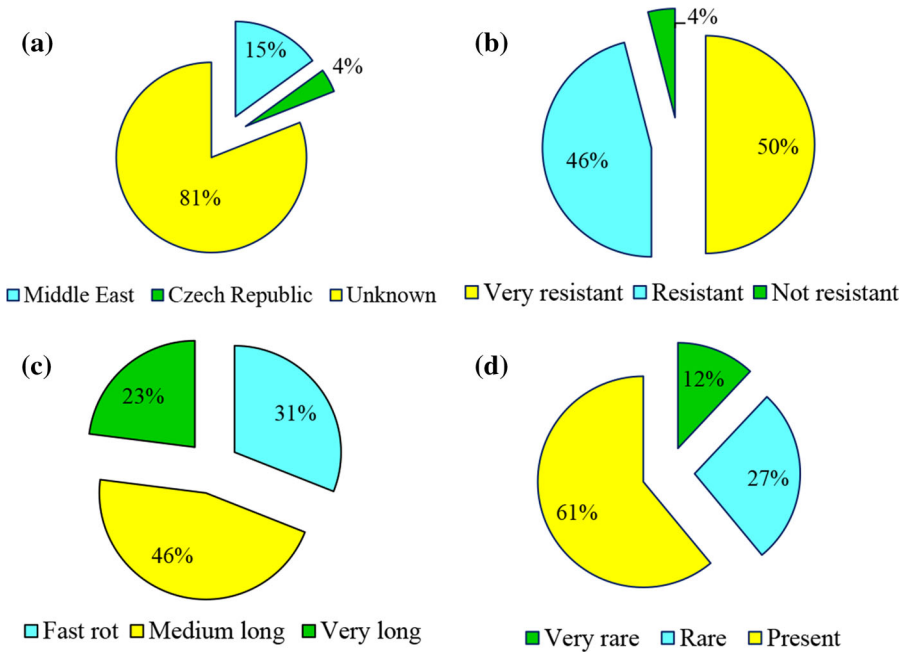

Fig. 4 **a** Origins of *Pyrus* varieties according to the answers of participants. **b** Resistance to diseases and pests according to the answers of participants. **c** Storage according to the answers of participants. **d** Availability in the field according to the answers of participants

of the fruit (*Kiseljača*—sour, *Rskavac*—crunchy, *Preseduša*—bad-tasting, *Tropa*—rotten, rapidly collapsing, *Budala*—foolish).

Ethnomedicinal use

The participants in this study answered several questions about traditional use of pears for medical purposes (Table 4). Fresh or dried fruits, juice, and compote are used as antihypertensive medicine (65.2%); as an antidiabetic and anticholesterol (63%), and anticonstipation remedy (54.3%); and for reduction of body mass (65.2%). Tea or decoction made from pear bark is a uroseptic (39.1%) and isused to treat urolithiasis (36.9%). Pear leaf tea and decoction are applied as antirheumatics (26%) and fresh fruit, juice or compote for cancer prevention (10.87%). Also, respondents indicated that the fruit is used in feeding babies (84.7%).

Pear is used similarly for medicinal purposes elsewhere in the Balkan region (Jarić et al. 2007, 2014; Mustafa et al. 2012a, b; Zlatković et al. 2014). In addition, pear (fruit, bark, leaves) is used in the form of a decoction against constipation (Mustafa et al. 2012a), prostatitis (Pieroni et al. 2014), as antihypertensive and anticholesterolemic remedy (Mustafa et al. 2012b), against hyperglycaemia (Šavikin et al. 2013), to lower triglyceride or for body detoxification (Jarić et al. 2015).

Phytochemical research showed that various parts of *P. communis* (leaves, bark, flowers, roots) act as antiinflammatory agents against diseases. The leaves are a source of bioactive compounds like arbutin, isoquercitrin, sorbitol, ursolic acid, astragalin, and tannin (Khare 2007).

Pharmacological studies revealed antimicrobial and antioxidant activities of pear fruits (Salta et al. 2010; Parle and Arzoo 2016; Reiland and Slavin 2015). Previous research (Parle and Arzoo 2016; Kaur and Arya 2012) showed that pear fruit contains a significant amount of vitamin C, which is more concentrated in the peel. Pears are also an excellent source of dietary fibre and an important source of potassium (Mahammad et al. 2010). Consumption of apples and pears on a daily basis is associated with 18% reduction in type 2 diabetes mellitus risk (Guo et al. 2017).

Pears are widely consumed as a major source of polyphenols (chlorogenic, syringic, ferulic, and coumaric acids), arbutin and epicatechin, and these compounds are known to possess notable antioxidant

Table 4 Ethnomedicinal use according to respondents' answers

Botanical name	Ethnomedicinal use	Plant part used	Methods of preparation	Administration route	Use value (UV)
Pyrus communis L.	Anticonstipation	Fruit	Fruit (fresh or dried)	Oral	25/46 (54.3%)
	Hypertension regulation	Fruit	Juice	Oral	30/46 (65.2%)
			Compote		
	Antidiabetic and cholesterol lowering	Fruit	Fresh fruit	Oral	29/46 (63%)
		Bark	Juice		
			Compote		
			Tea		
			Decoction		
	Uroseptic	Bark	Tea	Oral	18/46 (39.1%)
			Decoction		
	Urolithiasis treatment	Leaf	Tea	Oral	17/46 (36.9%)
			Decoction		
	Antirheumatic	Leaf	Tea	Oral	12/46 (26%)
			Decoction	Pledget	
	Body mass reduction	Fruit	Fresh fruit	Oral	30/46 (65.2%)
			Juice		
			Compote		
	Cancer prevention	Fruit	Fresh fruit	Oral	5/46 (10.87%)
			Juice		
			Compote		
	Hypoallergenic (Baby food)	Fruit	Fresh fruit	Oral	39/46 (84.7%)
			Juice		
			Compote		

activities (Imeh and Khokhar 2002; Carbonaro et al. 2002).

Traditional use and consumption

The research of Polimlje shows that pears are consumed predominantly as fresh fruit, or processed into various products: in pies and cakes, brandy, compote, juice, jam, syrup, sita, slatko, vodnjika, turšija or dried fruit (used for tea or compote), etc. There is no exactly correlation between each variety of the pear with the product made from it, but the participants themselves determine how best to use the fruit. However, there is regularity, that the early summer varieties (June–July) are more used as fresh for food, because they are not suitable for processing (higher quantity of water and less quantity of sugar), and later summer and autumn varieties (August–October) are used for consuming and processing. Due to the short durability of the fruit many pears are lost unused, or used for animal feed.

The research shows that in Serbian households of the Polimlje region, high-quality home-brewed wild pear brandy (*rakija kruškovača)* is produced, that can be found on the local markets in small quantities at a rather high price. In eastern Albania, pear brandy is made in a similar way (Pieroni et al. 2014, 2015).

The participants have specify traditional drink—*vodnjika* (watery), that has been prepared for decades in households in Polimlje. *Vodnjika,* a sweet, slightly carbonated fizzy drink, rich in fruit acid, is prepared as follows: pears (sometimes combined with apples or medlars) are cut and dried in the sun, then put in casks, where they are soaked in water and left to rest for some time. Low fermentation results in a slightly carbonated, sweet drink, which is consumed during the winter. *Takiša* variety (small, hard, and bitter fruits) is usually used for preparing *vodnjika*. It is believed that *vodnjika* has the beneficial effect of lowering high blood pressure. This drink is used by both adults and children. *Vodnjika* is also prepared in central Serbia (Savić 2014).

In the conducted research we found one more traditional product in Muslim households- *sita* (meaning "not hungry"), which is being prepared only in Polimlje, nowhere else. S*ita* is a thick brown apple and pear syrup prepared from the pulp of sweet or sour juicy fruits and obtained by squeezing and boiling fruit juice from the pulp. It is consumed in confections, diluted in water as juice, and also in pancakes with mild milk cream, or else as sweet (*slatko*). The shelf life of *sita* is unlimited.

In addition, pears fruits can be cooked and processed into *jam*, combined with apple or quince, or to obtain a *pekmez,* thickened jam-like product. *Pekmez* is made in the same way in the neighborhood countries (Pieroni et al. 2013, 2014).

The second favorite traditional product of the inhabitants of the explored area is *slatko* (sweet). It is boiled fruit in sugar syrup that is preserved in glass jars and used in the morning, with coffee, or else is served to guests visiting the household. It can be made from various peeled fruits, including pear fruit. *Slatko* is made in Polimlje, as well as elsewhere in Serbia and the Western Balkans (Dajić-Stevanović et al. 2014; Savić 2016).

In Polimlje, pears are also used for making juice (fresh or cooked) in combination with the juice of other fruits such as apple, apricot, cherry, etc. Dried pears, that are prepared in traditional dryers (on sun or wood energy), are used for consuming and making compote or tea. They are also used as baby food (as a compote or smashed).

Some winter pears (*Zimnjača, Turšijara*) have a sour taste, with low sugar content and high content of fruit acid compounds, and their fruits are used in Polimlje for *turšija* (meaning "sourish"), consisting of fruit preserved fresh in glass jars with water and pickled vegetables for consumption during winter. The participants said that some winter pear varieties can be stored in a cold room or in a separate wood auxiliary building, often placed in straw or with aromatic plants, which gives them a specific aroma.

Some medieval records show that pears were roasted in open fires or were cooked in a pot and eaten as main food or as a dessert (Savić 2014).

Conclusions

The Polimlje region in southwest Serbia is a unique multiethnic complex of architectural, historical, natural, and the resource of ethnobotanical knowledge that has persisted throughout the centuries.

The present ethnobotanical study is focused on the presence of 26 autochthonous pear varieties, methods of farming them, their traditional use, as well as on consumption of pears and their ethnomedicinal use in the region. This study represents the first written document about the ethnobotanical values of recorded varieties. However, depopulation of the investigated area provokes the disappearance of pear varieties, with consequent irretrievable depletion of the gene pool and loss of traditional knowledge. Preservation in situ can be achieved by raising the awareness and improving personal enthusiasm of the general population, as well as by preventing migration with financial support of the State. Ex situ conservation programmes includes making experimental fields, clonal archives and orchards, as well as germplasm bank. Major priority should be given to the combination of in situ and ex situ methods. Also, one of the ways of protection is to register the traditional *Pyrus* varieties in the Biodiversity Database of Serbia and Balkans.

In order to protect autochthonous pear varieties, our future studies will be carried out both at the genetic level aiming to assess genetic diversity and origin of the autochthonous varieties and at the phytochemical level in order to investigate the biological activities of *Pyrus* varieties.

Acknowledgements The authors are grateful to Bora Milićević for drawings of *Pyrus* varieties. They are also grateful to Mr. Raymond Dooley for proofreading the text and improving the English. This work was supported by the Ministry of Education, Science, and Technological Development of Serbia (Grants 173018, 173029, TR 31005).

Compliance with ethical standards

Conflicts of interest The authors declare no conflict of interests.

Ethical approval The ethnobotanical research "Ethnobotanical study and traditional use of autochthonous pear varieties (*Pyrus communis* L.) in Southwest Serbia (Polimlje)" and related activities, including collecting of plants, compiling databases, images, data recordings, gathering information on the uses of traditional knowledge or other elements of biocultural

heritage found in the study area, were undertaken in compliance with the ISE Code of Ethics (http://ethnobiology.net/code-of-ethics/).

No harmful consequences (biological or cultural) for the local people and local communities arose from this research and its related activities. Each information has been recorded with the approval of the informants. During research, all principles of the Code of Ethics were adhered to including intellectual property rights and support to the development of local people's cultures.

Informed consent Informed consent was obtained from all individual participants included in the research "Ethnobotanical study and traditional use of autochthonous pear varieties (*Pyrus communis* L.) in Southwest Serbia (Polimlje)". Each information has been recorded with the approval of the informants.

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