The plants traditionally used for the treatment of respiratory infections in the Balkan Peninsula (Southeast Europe)

Marija Marković[1,*], Dejan Pljevljakušić[2], Jelena Matejić[3], Biljana Nikolić[4], Mirjana Smiljić[5], Gorica Đelić[6], Olivera Papović[5], Mrđan Đokić[1], and Vesna Stankov Jovanović[1]

[1] *University of Niš, Faculty of Sciences and Mathematics, Višegradska 33, 18000 Niš, Serbia*
[2] *Institute for Medicinal Plants Research "Dr. Josif Pančić", Tadeuša Koščuška 1, 11000 Belgrade, Serbia*
[3] *University of Niš, Faculty of Medicine, Bulevar dr Zorana Đinđića 81, 18108 Niš, Serbia*
[4] *Institute of Forestry, Belgrade, Kneza Višeslava 3, 11030 Belgrade, Serbia*
[5] *University of Priština in Kosovska Mitrovica, Faculty of Science and Mathematics, Lole Ribara 29, 38220 Kosovska Mitrovica, Serbia*
[6] *University of Kragujevac, Faculty of Science, Radoja Domanovića 12, 34111 Kragujevac, Serbia*
[*] *Corresponding author: markovicsmarija9@gmail.com*

Published: December 25, 2022
Received: September 24, 2022
Accepted: December 16, 2022
Published on-line: December 23, 2022

Our study's objective was to systematize knowledge and traditional usage of plants against respiratory infections among the population in Serbia, based on literature data, and compare these results with published ethnomedicinal studies conducted in other territories of Balkan region. The study aimed to produce a review that can be a basis for further investigation, which may eventually lead to anti-viral agents' development. The ethnobotanical surveys we comprised in this review include 18 localities dispersed across the Balkan Peninsula, including the rural regions of Greece, Albania, Bosnia and Herzegovina, Serbia, and Montenegro. These surveys identified 213 plants from 57 families represented in the folk medicine of the studied region. The primary indications of reported plant taxa in ethnobotanical studies in the Balkan Peninsula were cough; common cold and cold prevention; pneumonia and pulmonary diseases, bronchitis, asthma, bronchial catarrh, chest pain; fever, headache, influenza; sore throat, laryngitis, pharyngitis, sinusitis, and inhalation; respiratory infections and respiratory diseases in general, and tuberculosis. Presented knowledge on the traditional use of plants against respiratory infections may serve as a basis and helpful guide for selecting plants that deserve new pharmacological and clinical studies, which may eventually lead to the development of efficient antimicrobial and anti-viral medicinal products.

Key words: Traditional medicine, respiratory infections, Balkan Peninsula, Serbia, phytotherapy

http://dx.doi.org/10.5937/leksir2242068M

1. INTRODUCTION

Respiratory infections are the most prevalent illnesses in the world. Although viruses most often cause them, antibiotics are often prescribed unnecessarily. The frequent use of antibiotics against respiratory disorders among the human population has led to antibiotic-resistant bacterial strains. Therefore, it is of utmost importance to evaluate alternative treatments such as herbal medications, whose efficacy and safety are proven in a long tradition in folk medicine and scientific pharmacological studies. The majority of the world's population relies on traditional medicine, especially in developing countries where some regions do not have other medical care types. Traditional knowledge about herbal medicine is extensively evaluated through ethnobotanical and ethnopharmacological surveys, many of which have been conducted in the last fifteen years in Serbia and broader in the Balkan Peninsula region.

Phytotherapy has always been the main form of traditional medicine in undeveloped countries, and it is becoming popular also in developed countries, where populations intend to stay healthy (Džamić and Matejić, 2017). According to the same authors, the human population's numerous pathological conditions could not be treated entirely by conventional pharmaceutical medications. It is the real reason that there is a growing tendency to use herbal drugs worldwide. The ways of use are determined with culture and personal attitude. An extended period of using phytotherapy in the past has demonstrated that it is safe and effective (WHO, 2000).

Many medicinal plants have specific actions and are also free of hazardous side effects (Schulz et al., 2001). Medicinal plants contain different active ingredients (Džamić and Matejić, 2017). In the practice of rational phytotherapy, single-herb products, which contain no additional herbal ingredients, are preferred. In contrast, for products with a fixed combination of several active ingredients, every component contributes to the remedy's positive evaluation (Schulz et al., 2001). Active pharmacological ingredients may positively affect human health, but any faulty use can lead to diverse complications due to the established cytotoxicity for many plant compounds (Džamić and Matejić, 2017). According to the same authors, further scientific studies need to provide additional evidence of herbs' safety and efficacy and their active ingredients in treating different pathological conditions.

Plants have a long history of traditional use to treat numerous pathological conditions, and we have inherited this knowledge (Janković et al., 2012). The present review is meant to describe the importance of medicinal plants in herbal medicine in treating respiratory infections. Today, the people of Serbia and many countries of the Balkan Peninsula practiced phytotherapy, the main form of traditional medicine, which is based on the use of plants, and usually different than conventional treatment (Džamić and Matejić, 2017). Also, in Serbia and other Balkan Peninsula countries, herbal preparations and official drug therapy are widespread (Živković et al., 2020) within the people, especially in the rural areas.

Moreover, acute lower respiratory tract infections are the most frequent diseases globally, commonly caused by viruses. Viral respiratory infections are usually classified as being caused by influenza, one of the most common viruses, or other viruses classified as non-influenza acute respiratory infections (Barrett, 2018).

There is still no satisfactory and proven cure for respiratory infections (Barrett, 2018). In terms of prevention, behavioral strategies such as hand washing, regular exercise, stress reduction training, and smoking avoidance can be effective and reduce the impact of viral acute respiratory infections among humans (Barrett, 2018).

Microbes' resistance to antimicrobial agents has been a problem since the use of the first antimicrobials. Previous studies indicate that antibiotics have adverse effects. Moreover, the cost and the risk of bacteria becoming resistant to antibiotics. Sharma et al. (2011) noted that children get fewer respiratory infections during the winter season when using the plant remedy regularly. Information on plant extracts' exact anti-viral action is not available (Barrett, 2018).

Herbal extracts are used in traditional medicine thanks to their antimicrobial effects. Descriptions of herbal therapies of the upper part of the respiratory system are the subjects of writing by many scientists, especially ethnobotanists. However, a relatively small number of traditional herbal drugs have been adequately tested for their pharmaceutical properties (Barrett, 2018).

2. ETHNOBOTANICAL AND ETHNOPHARMACOLOGICAL STUDIES IN SERBIA AND THE OTHER AREAS OF BALKAN PENINSULA

The knowledge of plants and their uses for medicinal purposes was transmitted from one generation to the next. This knowledge of plants used by people in different geographical areas has been documented in ethnobotanical studies, and it is related to plant determination and conservation (Džamić and Matejić, 2017). Ethnobotanical and ethnopharmacological investigations are a crucial starting point in developing medicinal drugs from natural sources. The rural regions of Southeast Europe are unique areas for ethnobotanical studies due to the significant mountainous regions' appearance, which are recognized as hotspots for both biodiversity and cultural diversity (Tsioutsiou et al., 2019). The area of the Balkan Peninsula is one of the most important centers of biodiversity in Europe, with about 6,340 different plant species, compared to 10,500 species in the Flora Europaea (Turrill, 1949), and with almost 8,000 plant taxa used in the folk medical heritage (Matejić et al., 2020). The history of people's medical culture from the Balkan is very complex because, in this part of Europe, intensive influences of eastern and western culture have been presented in the past (Živković et al., 2020). In the last fifteen years, extensive ethnopharmacological surveys have been conducted on the Balkan Peninsula. These studies covered regions such as Northern Albanian Alps (Pieroni et al., 2005), Kopaonik Mt. (Jarić et al., 2007), middle, south and west Bosnia and Herzegovina (Šarić Kundalić et al., 2010), Prokletije Mts. (Menković et al., 2011), South-Western Serbia – Pešter Plateau, Sandžak (Pieroni et al., 2011), Zlatibor district (Šavikin et al., 2013), Macedonia - Sharr Mts. (Rexhepi et al., 2013), Eastern Albania – Peshkopia (Pieroni et al., 2014a), Rtanj Mt. (Zlatković et al., 2014), Eastern Albania – Raicë and Mokra (Pieroni et al., 2014b), South Kosovo and Metohija (Mustafa et al., 2015), Suva Planina Mts. (Jarić et al., 2015a), North-Eastern Bosnia and Herzegovina (Šarić Kundalić et al., 2010), Negotin Krajina (Janković et al., 2012), Northern Greece, Edessa – Naoussa (Tsioutsiou et al., 2019), Svrljig and Timok region (Matejić et al., 2020), and Pčinja district (Živković et al., 2020). On the other hand, some regions remain poorly explored from an ethnobotanical perspective, despite their high floristic and vegetation diversity.

Serbia's region is situated in the central part of the Balkan Peninsula, covering an area of 88,766 km^2. The influence of different climates on Serbia's territory caused the richness of species and ecosystem diversity (Matejić et al., 2020). Republic of Serbia's territory encompasses 1,000 – 1,500 plant taxa used as food, spices, medicinal plants, food preservatives, natural dyes, or additives. According to Džamić and Matejić (2017) about 700 medicinal plant taxa exist on this territory, comprising 10.7 % of total flora, with 3,662 plant taxa. Many plants contain active principles with strong biological activity. According to Turudija-Živanović et al. (2014) around 280 medicinal plant species are in commercial trade sales in medicinal plant shops and pharmacies in Serbia. The population in rural areas in some regions of Serbia does not have adequate medical care because of the inability to get health insurance, and the reason is the residents' poverty (Živković et al., 2020; Matejić et al., 2020). According to the same authors, the first choice of healthcare in these underdeveloped Serbia regions is the use of medicinal plants. Many households in rural parts of Serbia collect herbal medicines from natural habitats, and their commercialization makes additional income (Turudija-Živanović et al., 2014).

3. THE PLANTS USED FOR THE TREATMENT OF RESPIRATORY INFECTIONS IN ETHNOBOTANICAL STUDIES ON BALKAN PENINSULA

Based on published data the previous two decades, the population from 18 localities on Balkan Peninsula was included in ethnobotanical surveys: Northern Albanian Alps, Kopaonik Mt., Middle, south and west Bosnia and Herzegovina, Prokletije Mts., Pešter Plateau – Sandžak region, Zlatibor district, Sharr Mts. (Macedonia), Peshkopia (Est. Albania), Rtanj Mt., Raicë and Mokra (Est. Albania), South Kosovo and Metohija, Suva Planina Mts., Konjuh Mts. (NE Bosnia and Herzegovina), Negotin Krajina, Edessa – Naoussa (Northern Greece), Svrljig region, Timok region, and Pčinja district (Figure 1). In each

of the studied regions, the population of different nationalities and cultures is represented in cohabitation, which has been using natural plant resources in traditional medicine for centuries. The methods of their preparation and application are now passed on from generation to generation. It has been noted that the population of Balkans uses 213 plant taxa in total can be utilized in treatments for respiratory infections (Table 1), which belong to 57 families. The most commonly used plant taxa were *Matricaria chamomilla* and *Tussilago farfara* (recorded at 12 localities), *Plantago major*, *Rosa canina*, and *Sambucus nigra* (11 localities each one), *Althaea officinalis*, and Thymus spp. (10 localities), *Primula veris* and *Salvia officinalis* (9 localities each one), *Achillea millefolium*, *Ocimum basilicum*, *Tilia cordata*, and *Verbascum* spp. (8 localities each one). The families with the most reported plant species were Lamiaceae (44 species), Rosaceae (22 species), and Asteraceae (18 species).

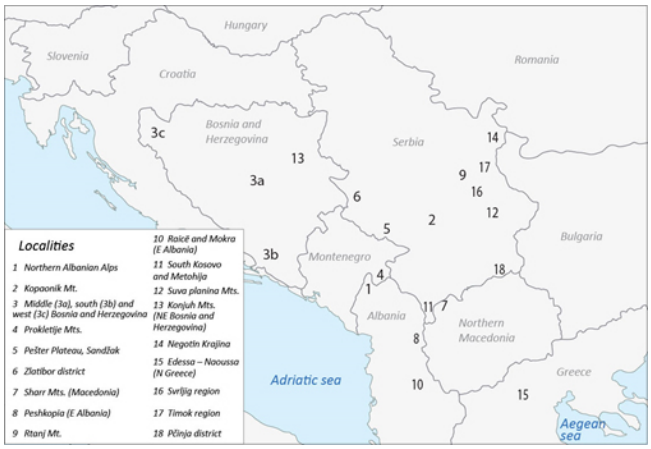

Fig. 1. Localities on Balkan Peninsula, included in ethnobotanical surveys.

Among the Serbian population, it was noticed 119 plant taxa against various respiratory disorders, and plant taxa reported for the treatment of respiratory infections were distributed in 41 families, out of which the main ones being Lamiaceae (26 species), Rosaceae (13 species), and Asteraceae (12 species). The population of other Balkan countries has also participated in ethnobotanical surveys. In these studies, 171 plant taxa from 48 families were reported, which can be used to treat respiratory infections.

3.1. The plants used for the treatment of respiratory infections in Northern Albanian Alps

The study was investigating the local traditions of using medicinal plants on the territory of Lëpushë (Northern Albanian Alps), the highest village in Albania and one of the most isolated in the entire Albanian Alps (Pieroni et al., 2005). This research includes studies and interviews of 25 inhabitants of this village. The total number of mentioned plants in the investigated area was 70. The number of mentioned plant species used only against respiratory infections was 7, of which *Hypericum maculatum*, *Asplenium scolopendrium*, *Salvia officinalis*, and *Urtica dioica* were with the highest values of quotation frequencies. *Rosa canina* and *Tilia cordata* were with moderate values, and *Primula veris* and *Tussilago farfara* with minor values of quotation frequencies.

3.2. The plants used for the treatment of respiratory infections on Kopaonik Mountain

On Kopaonik Mountain, ethnobotanical study included interviews of 60 inhabitants, around 60 years old (Jarić et al., 2007). In this study, 83 plant taxa were reported, of which 32 plant taxa (38.55 %) were against respiratory system diseases. Respiratory ailments were in the third place of the most frequently reported medicinal uses, behind gastrointestinal illnesses and skin injures. *Achillea millefolium*, *Matricaria chamomilla*, *Origanum vulgare*, *Plantago lanceolata*, *P. major*, *P. media*, *Stachys officinalis*, *Thymus serpyllum*, *Urtica dioica*, *Verbena officinalis*, *Veronica officinalis* were with the highest degree of presence in the treatment of respiratory diseases, based on the presence of species in distinct communities.

3.3. The plants used for the treatment of respiratory infections in Bosnia and Herzegovina

Ethnobotanical study on the medicinal use of plants in middle, south, and west Bosnia and Herzegovina, included studies and interviews of 51 inhabitants, around 65 years old, was presented with 228 wild and cultivated plant taxa (belonged to 50 families and 124 genera) and 730 different preparations for the use in human therapy (Šarić Kundalić et al., 2010). Respiratory system disorders were the most frequently mentioned indications: 76 plant taxa (33.33 %) were listed against various respiratory infections, of which 29 (12.72 %) were used in the form of a single component, and 47 taxa (20.61 %) were used in the form of mixtures.

3.4. The plants used for the treatment of respiratory infections on Prokletije Mountains

On Prokletije Mountains (Montenegro), ethnobotanical studies included interviews of 75 inhabitants (29 male, 46 female), 40 – 82 years old (Menković et al., 2011). In this study, 94 plant taxa were reported, of which 30 plant taxa (31.91 %) were listed against respiratory diseases. After the gastrointestinal group of diseases, the second most frequently reported medicinal uses were respiratory system diseases. *Abies alba* Miller, *Origanum vulgare* L., *Rubus fruticosus* L., *Sambucus nigra* L., *Thymus serpyllum* L., *Vaccinium myrtillus* L., *Verbascum densiflorum* Bertol., *Verbascum phlomoides* L., *Verbascum thapsus* L., and *Viola tricolor* L. were the plants with the highest frequency.

3.5. The plants used for the treatment of respiratory infections in Sandžak

In Sandžak, Pešter Plateau, in Southwestern Serbia, 62 plants were noticed, to represent the remaining folk medical heritage of this area, reported by 42 respondents, age between 43 – 93 (Pieroni et al., 2005). The highest number of plants (26 plant species, 41.94 %) was used to treat respiratory system diseases.

3.6. The plants used for the treatment of respiratory infections in Zlatibor district

The medicinal plants' knowledge was documented in South-Western Serbia – Zlatibor district (Šavikin et al., 2013). Ethnobotanical studies included interviews of 220 inhabitants, of which 46 were male, and 174 female, 16 – 80 years old. In this study, 69 plant taxa were reported, of which 20 plant taxa (28.99 %) were against respiratory system diseases. The second most frequently reported medicinal uses were ones for respiratory problems, behind gastrointestinal ailments.

3.7. The plants used for the treatment of respiratory infections in the Sharr Mountains

An ethnobotanical study was conducted among Albanians, Macedonians, and Gorani in 41 villages located in the Sharr Mountains in Western Macedonia (Rexhepi et al., 2013). This research included interviews of 221 inhabitants, around 55 years old. The most frequently cited medicinal uses referred to the treatment of respiratory system conditions (46 %). In this study, 76 mainly wild taxa belonging to 34 families were mentioned by respondents, of which 25 plants (32.89 %) were

against respiratory system diseases. *Capsella bursa-pastoris* (L.) Medicus, *Malva sylvestris* L., *Mentha longifolia* (L.) Hudson, *Rosa canina* L., *Rubus ulmifolius* Schott, *Sambucus nigra* L., *Saponaria officinalis* L., and *Vaccinium myrtilus* L. were mentioned by respondents in 35 villages, *Verbascum phlomoides* L. in 19 villages, and *Mentha* × *piperita*, and *Pinus sylvestris* in 15 villages, each one. The other plant species were mentioned in the smaller number of villages on the mountain.

3.8. The plants used for the treatment of respiratory infections Peshkopia in Eastern Albania

In the region of Peshkopia in Eastern Albania, Pieroni et al. (2014b) were found 84 plant taxa to represent the remaining folk medical heritage of the area, reported by 32 respondents, age between 9 – 83. In this ethnobotanical study, 10 plant species (11.9 %) were reported to treat respiratory system diseases. These plant species were *Sambucus nigra*, *Allium sativum*, *Hypericum perforatum*, *Juglans regia*, *Mentha longifolia*, *Origanum vulgare*, *Stachys tymphaea*, *Prunus domestica*, *Prunus cerasiferum*, and *Rosa canina*. Of the remedies cited for human use, the respiratory system disorders were behind the treatments of skin diseases, gastrointestinal, urogenital, and musculoskeletal diseases.

3.9. The plants used for the treatment of respiratory infections on Rtanj Mountain

Another ethnobotanical study was included 37 inhabitants (18 male and 19 female) aged between 55 – 78, on the Rtanj Mountain, Eastern Serbia (Zlatković et al., 2014), where 45 plant taxa were mentioned by respondents, of which 18 (40 %) were reported against respiratory system infections. The following plant species were estimated with quotation frequency higher than 1: *Centaurium erythraea*, *Malus sylvestris*, *Matricaria chamomilla*, *Mentha pulegium*, *Plantago major*, *Primula veris*, *Rubus ulmifolius*, *Sambucus nigra*, *Taraxacum officinale*, *Tilia cordata*, and *Tilia platyphyllos*. Zlatković et al. (2014) mentioned that endemic species *Satureja kitaibelii*, commonly known as Rtanj tea in Serbia, is a symbol of this mountain, which is distributed in Eastern Serbia and Western Bulgaria, is used in the treatment of respiratory system disorders. Among the inhabitants of the mountain, a strictly endemic species *Nepetae rtanjensis herba*, reported exclusively from Rtanj Mountains, also indicated as a remedy for inflammation of the upper part of the respiratory tract, that is protected taxa in the Red Data Book of the Flora of Serbia (Stevanović, 1999).

3.10. The plants used for the treatment of respiratory infections in Raicë and Mokra – Eastern Albania

Pieroni et al. (2014b) were studied the traditional use of medicinal plants in Raicë and Mokra – Eastern Albania. The research included studies and interviews of 36 inhabitants (24 male, 12 female), 37 – 95 years old. It was recorded 59 plant taxa, of which 14 (23.73 %) were reported against respiratory infections: *Malus domestica*, *Rubus ulmifolius*, *Cornus mas*, *Primula veris*, *Rosa canina*, *Vitis labrusca*, *Crataegus monogyna*, *Tilia cordata*, *Sideritis raeseri*, *Origanum vulgare*, *Prunus domestica*, *Cydonia oblonga*, *Juglans regia*, and *Orchis* sp.

3.11. The plants used for the treatment of respiratory infections in South Kosovo and Metohija

The knowledge of medicinal plants which was documented in South Kosovo and Metohija included interviews of 139 inhabitants (92 male, 47 female) older than 50 years (Mustafa et al., 2015). The second most frequently cited medicinal uses, behind gastrointestinal ailments, were referred to as the group of respiratory infections. It was mentioned 141 plant species, of which 43 (30.50 %) were reported against respiratory system diseases. *Allium sativum*, *Matricaria chamomilla*, *Sambucus nigra*, *Thymus serpyllum*, *Tilia platyphyllos*, *Urtica dioica*, and *Vaccinium myrtillus* were the most frequently cited.

3.12. The plants used for the treatment of respiratory infections on Suva Planina Mountains

On Suva Planina Mountains, in South-Eastern Serbia, were noticed 128 plants, reported by 66 respondents (37 male, 29 female), age between 49 – 90, of which 47 plant taxa (36.72 %) were against respiratory system diseases (Jarić et al., 2015a). *Achillea millefolium*, *Allium cepa*, *Allium sativum*, *Hypericum perforatum*, *Juglans regia*, *Matricaria chamomilla*, *Mentha* × *piperita*, *Plantago lanceolata*, *Plantago major*, *Salvia officinalis*, *Sempervivum tectorum*, *Thymus serpyllum*, and *Tilia cordata* were with the highest use-values. The most frequent conditions treated with medicinal plants were respiratory system diseases.

3.13. The plants used for the treatment of respiratory infections in the Konjuh Mountains

A survey conducted in the Konjuh Mountains, NE Bosnia, and Herzegovina, included 10 inhabitants aged around 65 where 92 wild and cultivated plants were mentioned by respondents, of which 50 (54.35 %) were reported against respiratory infections (Šarić Kundalić et al., 2010). The second most frequently reported medicinal treatments were respiratory system disorders (21.5 % of the mentioned applications), behind gastrointestinal system disorders (26.5 %).

3.14. The plants used for the treatment of respiratory infections in Negotin Krajina

In Negotin Krajina, Eastern Serbia was noticed 37 plants to represent this area's remaining folk medical heritage, reported by 34 interviewed people, ages between 21 – 88 (Janaćković et al., 2019). In this study, 13 plant taxa (35.14 %) were against respiratory system infections. In the third place, respiratory system disorders were the most cited medicinal use behind treating immune and digestive systems. The mentioned plant species for the respiratory infection treatments were *Althaea officinalis*, *Hedera helix*, *Majorana hortensis*, *Pinus nigra*, *Pinus sylvestris*, *Plantago major*, *Primula vulgaris*, *Prunus avium*, *Quercus petraea*, *Robinia pseudoacacia*, *Salvia officinalis*, *Tilia tomentosa*, and *Urtica dioica*.

3.15. The plants used for the treatment of respiratory infections in Edessa – Naoussa, Northern Greece (Central Macedonia)

In Northern Greece, Edessa – Naoussa (Central Macedonia) 87 plant taxa were found to represent the remaining folk medical heritage of the area, reported by 96 respondents (37 male, 59 female), age between 24 – 94 (Tsioutsiou et al., 2019). The highest number of plants (21 plant species, 24.14 %) was used to treat respiratory system diseases. Medicaments of respiratory illnesses were highly cited by informants, independently from their job and educational level. *Sideritis scardica* was one of the most important plants, quoted as effective for respiratory diseases' treatment, followed by *Tilia platyphyllos*, *Sambucus nigra*, *Malva sylvestris*, *Dactylorhiza sambucina*. *S. scardica* is an aromatic prevalent in Greece, Bulgaria, Albania, and North Macedonia, where primarily used in local cuisines. Aerial parts of plants from genus *Sideritis* are known as a 'mountain tea,' which is widely used in the folk medicine of the Balkan as tea due to its antimicrobial properties (Pljevljakušić et al., 2011) and has been used for the decoctions' preparation to treat cold, influenza, shortness of breath, and sinus congestion (Tsioutsiou et al., 2019). Traditionally, plants' infusion from genus *Sideritis* (*S. scardica*, *S. clandestina*, *S. raeseri*, *S. syriaca*) has been

applied against the common cold cough relief (Kokina et al., 2019).

3.16. The plants used for the treatment of respiratory infections in the Svrljig region

In the Svrljig region, South-Eastern Serbia, Matejić et al. (2020) were noticed 87 plants, reported by 67 respondents (24 male, 43 female), age between 20 – 90, of which 41 plant taxa (47.13 %) were against respiratory system diseases. According to the Institute for public health report, the population of the Svrljig region usually has problems with respiratory system diseases. According to the ethnobotanical survey, the most common organ system treated by botanical drugs were the immune and respiratory systems. The survey noted that respondents usually used *Marrubium vulgare*, *Satureja montana*, and *Sambucus nigra* to treat productive cough and bronchitis. The rhizome of *Althaea officinalis* is also frequently used to treat respiratory problems, which is prepared by cold maceration: boiled and cooled water is poured over the rhizome, and after 2 h, the preparation is ready to use. Aerial parts of species from the genus *Thymus* are prepared in the form of tea for different respiratory infections. The syrups against respiratory infections are made from the following plant species: *Melissa officinalis*, *Symphytum officinale*, *Tussilago farfara*, *Primula veris*, and *Papaver rhoeas*. These syrups are prepared by adding about 1.5 kg of sugar to 1 liter of strained tea and then boiled for 1 hour.

3.17. The plants used for the treatment of respiratory infections in the Timok Region

In the Timok region, Eastern Serbia, Matejić et al. (2020) were noticed 31 plants, reported by 94 interviewed people (33 male, 61 female), age between 48 – 79, of which 23 plant taxa (74.19 %) were against the respiratory system disorders. The most common diseases among the village population of the Timok region are problems with the digestive system, intestinal infectious diseases, and respiratory infections. During the ethnobotanical research, it was noted that respondents usually used *Polygonum aviculare* against bronchitis and productive cough and *Teucrium chamaedrys* against bronchitis and tuberculosis. *Teucrium polium* ssp. *capitatum* from the Balkan Peninsula has compounds in essential oils with high biological activity (Mitić et al., 2012). Herbal drugs, with the most significant number of citations, used for treating respiratory tract diseases were *Sambuci flos*, *Thymi herba*, *Thymi flos*, *Melissae herba*, *Armoraciae radix*, and *Polygoni avicularis herba*. *Sambucus nigra* is primarily used for the respiratory system (bronchitis, productive cough), with the theoretical meaning of moderate importance for investigated Svrljig and Timok region areas, but with relatively high values of indices for both regions.

3.18. The plants used for the treatment of respiratory infections in Pčinja district

The medicinal plants' knowledge was documented in Pčinja district, Southeastern Serbia, which included interviews of 113 inhabitants (30 male, 81 female), 17 – 74 years old (Živković et al., 2020). In this study, 86 plant taxa were reported, of which 25 plant taxa (29.07 %) were against respiratory system diseases. The most frequent medicinal uses were for treating diseases of the digestive system and respiratory system. Respiratory diseases are the most common causes for going to the health care centre, which is reflected in herbal remedies. *Achillea millefolium*, *Althaea officinalis*, *Crataegus monogyna*, *Hypericum perforatum*, *Matricaria chamomilla*, *Ocimum basilicum*, *Salvia officinalis*, *Thymus serpyllum*, and *Urtica dioica* were with the highest number of user reports.

4. THE PLANTS USED FOR THE TREATMENT OF RESPIRATORY INFECTIONS IN THE BALKANS

4.1. The frequently used plants in the treatment of respiratory infections

It has been noted that the population of Serbia and neighboring regions in the Balkans uses 213 plant taxa in total can be used in treatments against respiratory infections, which belong to 57 families. The families with the most reported plant species were Lamiaceae (44 species), Rosaceae (22 species), and Asteraceae (18 species). The most commonly used plant taxa were *Matricaria chamomilla* and *Tussilago farfara* (recorded at 12 localities each), *Plantago major*, *Rosa canina*, and *Sambucus nigra* (11 localities each one), *Althaea officinalis*, and *Thymus* sp. (10 localities), *Primula veris* and *Salvia officinalis* (9 localities each one), *Achillea millefolium*, *Ocimum basilicum*, *Tilia cordata*, and *Verbascum* sp. (8 localities each one).

The most frequently used plant species in the treatment of respiratory system diseases at most of the investigated localities in Serbia, among the Serbian population, were *Plantago major* (8 localities), *Achillea millefolium*, *Althaea officinalis*, *Matricaria chamomilla*, and species from genus *Thymus* (7 localities each one), *Inula helenium*, *Primula veris*, and *Tussilago farfara* (6 localities each one), *Ocimum basilicum*, *Pinus sylvestris*, *Rosa canina*, *Sambucus nigra*, *Salvia officinalis*, and *Tilia cordata* (5 localities each). The families with the most frequently reported plant species among the people of other Balkan territories were Lamiaceae (33 species), Rosaceae (18 species), and Asteraceae (13 species). The most frequently mentioned plant taxa used at most of the localities in Balkan countries except among the Serbian population were *Rosa canina*, *Sambucus nigra*, *Tussilago farfara* (noted at 6 localities each one), *Matricaria chamomilla* and *Origanum vulgare* (5 localities each one).

Matricaria chamomilla

Chamomile (*Matricaria chamomilla*) has a long history of traditional medicine use, with a broad spectrum of applications. The common cold is one of five indications in traditional usage (EMA, 2015). Dajić Stevanović et al. (2014) found that Serbia's population uses chamomile flower-heads in the form of tea against coughs, bronchitis, fever, and colds, and externally against larynx and pharynx inflammation.

The ethnomedicinal uses of *Matricaria chamomilla* in the treatment of respiratory system diseases among the Serbian population were: inhalation for sinusitis (Jarić et al., 2007), cough (Živković et al., 2020; Jarić et al., 2015a; Pieroni et al., 2011), sore throat (Pieroni et al., 2011), cold (Jarić et al., 2015a; Šavikin et al., 2013; Zlatković et al., 2014), laryngitis (Jarić et al., 2015a), and pharyngitis (Matejić et al., 2020). The most common way of applying traditional use in Pirot County (Southeastern Serbia) was a herbal tea for oral use against cold and throat infection (Marković et al., 2020a).

The folk medical heritage about the use of *Matricaria chamomilla*, mentioned against respiratory infections among the population of other Balkans territories, includes the following applications: throat inflammations (Šarić Kundalić et al., 2010; 2016), throat ache (Šarić Kundalić et al., 2010), cough (Menković et al., 2011; Tsioutsiou et al., 2019), bronchitis (Menković et al., 2011), fever and cold (Menković et al., 2011), antitussive, against influenza and oral cavity infections (Mustafa et al., 2015), respiratory system disorders in the general and common cold (Šarić Kundalić et al., 2010).

Table 1. A comparative review of the traditional use of medicinal plants against respiratory infections in the Balkans: 1. Northern Albanian Alps (Pieroni et al., 2005), 2. Kopaonik Mt. (Jarić et al., 2007), 3. Middle, south, and west Bosnia and Herzegovina (Šarić Kundalić et al., 2010), 4. Prokletije Mts. (Menković et al., 2011), 5. Pešter Plateau (Pieroni et al., 2005), 6. Zlatibor district (Šavikin et al., 2013), 7. Sharr Mts. (Rexhepi et al., 2013), 8. Peshkopia (Pieroni et al., 2014a), 9. Rtanj Mt. (Zlatković et al., 2014), 10. Raicë and Mokra (Pieroni et al., 2014b), 11. South Kosovo and Metohija (Mustafa et al., 2015), 12. Suva Planina Mts. (Jarić et al., 2015a), 13. Konjuh Mts. (Šarić Kundalić et al., 2016), 14. Negotin Krajina (Janaćković et al., 2019), 15. Edessa – Naoussa (Tsioutsiou et al., 2019), 16. Svrljig region (Matejić et al., 2020), 17. Timok region (Matejić et al., 2020), 18. Pčinja district (Živković et al., 2020).

Application	Region	Number of taxa	Taxa used	Reference
Antitussive	2. Kopaonik Mt.	8	*Agrimonia eupatoria* (anti-tus), *Alcea rosea* (anti-tus), *Althaea officinalis* (anti-tus), *Inula helenium* (anti-tus), *Malva sylvestris* (anti-tus), *Plantago lanceolata* (anti-tus), *Plantago major* (anti-tus), *Plantago media* (anti-tus)	(Jarić et al., 2007)
	7. Sharr Mts.	3	*Bellis perennis* (anti-tus), *Castanea sativa* (anti-tus), *Clinopodium grandiflorum* (anti-tus)	(Rexhepi et al., 2013)
	8. Peshkopia	1	*Sambucus nigra* (anti-tus)	(Pieroni et al., 2014a)
	11. South Kosovo and Metohija	19	*Althaea officinalis* (anti-tus), *Castanea sativa* (anti-tus), *Corylus avellana* (anti-tus), *Citrus* × *limon* (anti-tus), *Inula helenium* (anti-tus), *Matricaria chamomilla* (anti-tus), *Malva sylvestris* (anti-tus), *Mentha longifolia* (anti-tus), *Mentha pulegium* (anti-tus), *Origanum vulgare* (anti-tus), *Primula veris* (anti-tus), *Pulmonaria officinalis* (anti-tus), *Rubus fruticosus* (anti-tus), *Sambucus nigra* (anti-tus), *Rubus fruticosus* (anti-tus), *Thymus vulgare* (anti-tus), *Tilia platyphyllos* (anti-tus), *Tussilago farfara* (anti-tus), *Verbascum* sp. (anti-tus)	(Mustafa et al., 2015)
Asthma	2. Kopaonik Mt.	7	*Achillea millefolium* (ba), *Althaea officinalis* (a), *Malva sylvestris* (a), *Inula helenium* (a), *Pimpinella saxifraga* (ba), *Stachys officinalis* (a), *Verbascum phlomoides* (a)	(Jarić et al., 2007)
	3. Bosnia and Herzegovina	24	*Achillea collina* (a-mix), *Achillea nobilis* (a-mix), *Centaurium erythraea* (a-mix), *Foeniculum vulgare* (a-mix), *Hypericum montanum* (a-mix), *Hypericum perforatum* (a-mix), *Hypericum tetrapterum* (a-mix), *Mentha arvensis* (a-mix), *Mentha* × *gracilis* (a-mix), *Mentha longifolia* (a-mix), *Mentha* × *piperita* (a-mix), *Pimpinella major* (a-mix), *Potentilla erecta* (a-mix), *Potentilla recta* (a-mix), *Potentilla reptans* (a-mix), *Ribes nigrum* (a-mix), *Ribes rubrum* (a-mix), *Ruta graveolens* (a-mix-dec), *Tussilago farfara* (a-mix), *Thymus comosus* (a-mix), *Thymus longidentatus* (a-mix), *Thymus praecox* (a-mix), *Thymus pulegioides* (a-mix), *Urtica dioica* (a-sc)	(Šarić Kundalić et al., 2010)
	4. Prokletije Mts	3	*Artemisia absinthium* (a), *Petasites hybridus* (a), *Stachys officinalis* (a)	(Menković et al., 2011)
	5. Pešter Plateau	1	*Primula veris* (a)	(Pieroni et al., 2011)
	7. Sharr Mts.	3	*Alcea rosea* (a), *Capsella bursa-pastoris* (a), *Malva sylvestris* (a), *Juniperus communis* (a)	(Rexhepi et al., 2013)
	11. South Kosovo and Metohija	4	*Artemisia absinthium* (anti-a), *Juniperus communis* (anti-a), *Sambucus nigra* (anti-a), *Thymus serpyllum* (anti-a)	(Mustafa et al., 2015)
	12. Suva Planina Mts.	3	*Hyssopus officinalis* (a), *Rubus fruticosus* (a), *Triticum* sp. (a)	(Jarić et al., 2015a)
	13. Konjuh Mts.	7	*Juniperus communis* (a), *Chelidonium majus* (a), *Ocimum basilicum* (a), *Symphytum officinale* (a), *Tussilago farfara* (a), *Valeriana officinalis* (a), *Verbascum* sp. (a)	(Šarić Kundalić et al., 2016)
	16. Svrljig region	6	*Artemisia absinthium* (a), *Juniperus communis* (a), *Levisticum officinale* (a), *Pinus sylvestris* (a), *Polypodium vulgare* (a), *Tussilago farfara* (a)	(Matejić et al., 2020)
	17. Timok region	3	*Glechoma hederacea* (a), *Ocimum basilicum* (a), *Robinia pseudoacacia* (a)	(Matejić et al., 2020)
	18. Pčinja district	1	*Ocimum basilicum* (a),	(Pieroni et al., 2011)
Bronchitis	1. Northern Albanian Alps	1	*Hypericum maculatum* (b)	(Pieroni et al., 2005)
	2. Kopaonik Mt.	8	*Althaea officinalis* (b), *Inula helenium* (b), *Malva sylvestris* (b), *Origanum vulgare* (b), *Pinus sylvestris* (cb), *Primula vulgaris* (b), *Stachys officinalis* (b), *Verbascum phlomoides* (b)	(Jarić et al., 2007)

	3. Bosnia and Herzegovina	13	*Achillea collina* (b-mix), *Achillea nobilis* (b-mix), *Centaurium erythraea* (b-mix), *Glechoma hederacea* (b-mix), *Glechoma hirsuta* (b-mix), *Hypericum montanum* (b-mix), *Hypericum perforatum* (b-mix), *Hypericum tetrapterum* (b-mix), *Tussilago farfara* (b-mix), *Thymus comosus* (b-mix), *Thymus longidentatus* (b-mix), *Thymus praecox* (b-mix), *Thymus pulegioides* (b-mix)	(Šarić Kundalić et al., 2010)
	4. Prokletije Mts.	11	i (b), *Matricaria chamomilla* (b), *Nasturtium officinale* (b), *Pinus mugo* (b), *Plantago lanceolata* (b), *Polygala amara* (b), *Stachys officinalis* (b), *Verbascum densiflorum* (b), *Verbascum phlomoides* (b), *Verbascum thapsus* (b), *Veronica officinalis* (b), *Viola odorata* (b), *Viola tricolor* (b)	(Menković et al., 2011)
	5. Pešter Plateau	1	*Sambucus nigra* (b)	(Pieroni et al., 2011)
	6. Zlatibor district	4	*Plantago lanceolata* (b), *Plantago major* (b), *Primula elatior* (b), *Primula veris* (b)	(Šavikin et al., 2013)
	7. Sharr Mts.	8	*Alcea rosea* (b), *Capsella bursa-pastoris* (b), *Malva sylvestris* (b), *Origanum vulgare* (b), *Pinus sylvestris* (cb), *Rosa canina* (b), *Sambucus nigra* (b), *Saponaria officinalis* (b), *Verbascum phlomoides* (cb)	(Rexhepi et al., 2013)
	8. Peshkopia	1	*Mentha longifolia* (b)	(Pieroni et al., 2014a)
	9. Rtanj Mt.	2	*Plantago major* (b), *Sambucus nigra* (b)	(Zlatković et al., 2014)
	11. South Kosovo and Metohija	11	*Castanea sativa* (b), *Citrus* × *limon* (b), *Malva sylvestris* (b), *Melissa officinalis* (b), *Primula veris* (b), *Pulmonaria officinalis* (b), *Raphanus sativus* (b), *Sambucus nigra* (b), *Thymus serpyllum* (b), *Urtica dioica* (b), *Verbascum* sp. (b)	(Mustafa et al., 2015)
	12. Suva Planina Mts.	6	*Hyssopus officinalis* (b), *Laurus nobilis* (b-dec), *Primula veris* (b), *Raphanus sativus* (b-ch), *Rubus fruticosus* (b), *Taraxacum campylodes* (b)	(Jarić et al., 2015a)
	13. Konjuh Mts.	8	*Brassica oleracea* (b), *Brassica rapa* (b), *Plantago lanceolata* (b), *Plantago major* (b), *Sambucus nigra* (b), *Symphytum officinale* (b), *Tussilago farfara* (b), *Verbascum* sp. (b)	(Šarić Kundalić et al., 2016)
	16. Svrljig region	5	*Achillea millefolium* (b), *Althaea officinalis* (b), *Marrubium vulgare* (b), *Rubus fruticosus* (b), *Thymus praecox* subsp. *jankae* (b)	(Matejić et al., 2020)
	17. Timok region	11	*Anethum graveolens* (b), *Glechoma hederacea* (b), *Mentha* × *piperita* (b), *Morus nigra* (b), *Plantago major* (b), *Polygonum aviculare* (b), *Robinia pseudoacacia* (b), *Teucrium chamaedrys* (b), *Tilia cordata* (b), *Thymus praecox* subsp. *jankae* (b), *Tropaeolum majus* (b)	(Matejić et al., 2020)
	18. Pčinja district	2	*Hyssopus officinalis* (b), *Tussilago farfara* (b)	(Pieroni et al., 2011)
Cold	2. Kopaonik Mt.	6	*Achillea millefolium* (col), *Alcea rosea* (col), *Mentha* × *piperita* (col), *Origanum vulgare* (col), *Rosa canina* (col), *Sambucus nigra* (col)	(Jarić et al., 2007)
	3. Bosnia and Herzegovina	13	*Althaea officinalis* (ccol-mix), *Filipendula ulmaria* (ccol-sc), *Filipendula vulgaris* (ccol-sc), *Malus domestica* (ccol-mix), *Malus sylvestris* (ccol-mix), *Malva moschata* (ccol-mix), *Malva sylvestris* (ccol-mix), *Ocimum basilicum* (ccol-sc), *Salvia grandiflora* (ccol-mix), *Salvia officinalis* (ccol-mix), *Salvia pratensis* (ccol-mix), *Tussilago farfara* (ccol-mix), *Verbascum* sp. (ccol-mix)	(Šarić Kundalić et al., 2010)
	5. Pešter Plateau	5	*Allium sativum* (col), *Fragaria vesca* (col), *Gentiana lutea* (col), *Rosa canina* (col), *Thymus pulegioides* (col)	(Pieroni et al., 2011)
	6. Zlatibor district	8	*Hibiscus sabdarifera* (col), *Matricaria chamomilla* (col), *Mentha* × *piperita* (col), *Ribes nigrum* (col), *Rosa canina* (col), *Rubus idaeus* (fat-aft-col), *Sambucus nigra* (col), *Tilia cordata* (col)	(Šavikin et al., 2013)
	7. Sharr Mts.	5	*Althaea officinalis* (col), *Mentha longifolia* (col), *Rosa canina* (col), *Thymus serpyllum* (col), *Verbascum phlomoides* (col)	(Rexhepi et al., 2013)
	8. Peshkopia	1	*Stachys tymphaea* (col)	(Pieroni et al., 2014a)
	9. Rtanj Mt.	7	*Arctium lappa* (col), *Malus sylvestris* (col), *Matricaria chamomilla* (col), *Mentha pulegium* (col), *Tilia cordata* (col), *Tilia platyphyllos* (col), *Thymus praecox* subsp. *jankae*	(Zlatković et al., 2014)
	10. Raicë and Mokra	1	*Stachys tymphaea* (col)	(Pieroni et al., 2014b)

	12. Suva Planina Mts.	24	*Achillea millefolium* (col), *Agrimonia eupatoria* (col), *Allium cepa* (col), *Artemisia absinthium* (col-ex), *Centaurium erythraea* (col-t), *Hypericum perforatum* (col), *Inula helenium* L. (col), *Matricaria chamomilla* (col), *Mentha* × *piperita* (col), *Mentha pulegium* (col), *Ocimum basilicum* (col-t), *Origanum vulgare* (col), *Pinus sylvestris* (col), *Primula veris* (col), *Robinia pseudoacacia* (col), *Rosa canina* (col), *Salvia officinalis* (col), *Sambucus nigra* (col), *Satureja hortensis* (col), *Rubus fruticosus* (col), *Telekia speciosa* (col), *Thymus serpyllum* (col), *Tilia cordata* (col), *Viola odorata* (col)	(Jarić et al., 2015a)
	13. Konjuh Mts.	9	*Betula pendula* (ccol), *Brassica rapa* (ccol), *Citrus* × *limon* (ccol), *Filipendula ulmaria* (ccol), *Juniperus communis* (ccol), *Malus domestica* (ccol), *Matricaria chamomilla* (ccol), *Robinia pseudoacacia* (ccol), *Sambucus nigra* (ccol)	(Šarić Kundalić et al., 2016)
	14. Negotin Krajina	3	*Pinus sylvestris* (col), *Robinia pseudoacacia* (col), *Tilia tomentosa* (col)	(Janaćković et al., 2019)
	15. Edessa – Naoussa	3	*Crocus sativus* (ccol-prev), *Dactylorhiza latifolia* (ccol), *Origanum dictamnus* (ccol)	(Tsioutsiou et al., 2019)
	18. Pčinja district	5	*Achillea millefolium* (col), *Hibiscus sabdarifera* (col), *Hypericum perforatum* (col), *Salvia officinalis* (col), *Thymus serpyllum* (col)	(Pieroni et al., 2011)
Cough	1. Northern Albanian Alps	4	*Hypericum maculatum* (cou), *Salvia officinalis* (cou), *Tilia cordata* (cou), *Tussilago farfara* (cou)	(Pieroni et al., 2005)
	2. Kopaonik Mt.	7	*Achillea millefolium* (cou), *Alcea rosea* (cou), *Althaea officinalis* (w-cou), *Castanea sativa* (con-cou), *Inula helenium* (cou), *Primula vulgaris* (cou-syr,t), *Sambucus nigra* (p), *Stachys officinalis* (cou)	(Jarić et al., 2007)
	3. Bosnia and Herzegovina	24	*Allium cepa* (dry-cou-sc, cou-mix-syr), *Althaea officinalis* (cou-sc), *Foeniculum vulgare* (cou-mix), *Centaurium erythraea* (cou-mix), *Glechoma hederacea* (cou-sc), *Glechoma hirsuta* (cou-sc), *Hordeum vulgare* (cou-mix), *Malus domestica* (cou-mix), *Malus sylvestris* (cou-mix), *Malva moschata* (dry-cou-mix), *Malva sylvestris* (dry-cou-mix), *Mentha arvensis* (cou-mix), *Mentha* × *gracilis* (cou-mix), *Mentha longifolia* (cou-mix), *Mentha* × *piperita* (cou-mix), *Ribes nigrum* (cou-mix), *Ribes rubrum* (cou-mix), *Salvia grandiflora* (dry-cou-mix), *Salvia officinalis* (dcou-mix), *Salvia pratensis* (dry-cou-mix), *Tussilago farfara* (dry-cou-mix), *Verbascum* sp. (dry-cou-mix), *Veronica austriaca* (cou-mix), *Veronica chamaedrys* (cou-mix)	(Šarić Kundalić et al., 2010)
	4. Prokletije Mts.	12	*Filipendula ulmaria* (cou), *Matricaria chamomilla* (cou), *Nasturtium officinale* (cou), *Pinus mugo* (cou), *Plantago lanceolata* (cou), *Polygala amara* (cou), *Stachys officinalis* (cou), *Thymus pulegioides* (spasm-cou), *Verbascum densiflorum* (cou), *Verbascum phlomoides* (cou), *Verbascum thapsus* (cou), *Viola odorata* (unspec-cou), *Viola tricolor* (w-cou)	(Menković et al., 2011)
	5. Pešter Plateau	17	*Achillea millefolium* (cou), *Arctium lappa* (cou), *Gentiana lutea* (cou), *Hypericum montanum* (cou), *Inula helenium* (cou), *Matricaria chamomilla* (cou), *Melissa officinalis* (cou), *Nepeta cataria* (cou), *Plantago major* (cou), *Primula veris* (cou), *Prunus domestica* (cou), *Pyrus communis* (cou), *Pyrus pyraster* (cou), *Rosa canina* (cou), *Thymus pulegioides* (cou), *Tussilago farfara* (cou), *Zea mays* (p)	(Pieroni et al., 2011)
	6. Zlatibor district	9	*Achillea millefolium* (cou), *Althaea officinalis* (cou), *Inula helenium* (cou), *Ocimum basilicum* (cou-inh), *Plantago lanceolata* (cou), *Plantago major* (cou), *Primula elatior* (cou), *Primula veris* (cou), *Tussilago farfara* (cou)	(Šavikin et al., 2013)
	7. Sharr Mts.	8	*Gentiana lutea* (cou), *Ligustrum vulgare* (cou), *Mentha* × *piperita* (cou), *Morus alba* (cou), *Origanum vulgare* (cou), *Saponaria officinalis* (cou), *Juniperus communis* (cou), *Tilia cordata* (cou)	(Rexhepi et al., 2013)
	8. Peshkopia	2	*Juglans regia* (cou), *Origanum vulgare* (cou)	(Pieroni et al., 2014a)
	9. Rtanj Mt.	5	*Althaea officinalis* (cou), *Arctium lappa* (cou), *Fragaria vesca* (cou), *Hedera helix* (cou), *Hyssopus officinalis* (cou)	(Zlatković et al., 2014)
	10. Raicë and Mokra	13	*Cornus mas* (cou), *Crataegus monogyna* (cou), *Cydonia oblonga* (cou), *Juglans regia* (cou), *Malus domestica* (cou), *Sideritis reiseri* (cou), *Orchis* sp. (cou), *Primula veris* (cou), *Prunus domestica* (cou), *Rosa canina* (cou), *Rubus ulmifolius* (cou), *Tilia cordata* (cou), *Vitis labrusca* (cou)	(Pieroni et al., 2014b)
	12. Suva Planina Mts.	16	*Achillea clypeolata* (sot-cou-t), *Allium cepa* (cou), *Allium sativum* (w-cou-ch), *Cydonia oblonga* (cou), *Matricaria chamomilla* (cou), *Plantago lanceolata* (cou-j-mix-h), *Plantago major* (cou-j-mix-h), *Raphanus sativus* (cou), *Rosa canina*(cou), *Salvia officinalis* (cou), *Sambucus nigra* (cou-syr,t), *Rubus fruticosus* (cou), *Taraxacum campylodes* (cou), *Thymus serpyllum* (cou), *Tilia cordata* (cou), *Tussilago farfara* (per-cou)	(Jarić et al., 2015a)

	13. Konjuh Mts.	17	*Allium cepa* (cou), *Brassica oleracea* (cou), *Chelidonium majus* (cou), *Citrus* × *limon* (cou), *Juniperus communis* (cou), *Malus domestica* (cou), *Mentha pulegium* (cou), *Ocimum basilicum* (cou), *Orchis morio* (cou), *Plantago lanceolata* (cou), *Plantago major* (cou), *Pulmonaria officinalis* (cou), *Ribes nigrum* (cou), *Sambucus nigra* (cou), *Symphytum officinale* (cou), (cou), *Tilia* × *euchlora* (cou), *Verbascum* sp. (cou)	(Šarić Kundalić et al., 2016)
	14. Negotin Krajina	6	*Hedera helix* (cou), *Pinus sylvestris* (cou), *Plantago major* (cou), *Robinia pseudoacacia* (cou)	(Janaćković et al., 2019)
	15. Edessa – Naoussa	19	*Achillea holosericea* (cou), *Alcea rosea* (cou), *Arum italicum* (cou), *Arum maculatum* (cou), *Dactylorhiza latifolia* (cou), *Hedera helix* (cou), *Linum usitatissimum* (cou), *Malva sylvestris* (cou), *Matricaria chamomilla* (cou), *Mentha* sp. (cou), *Origanum dictamnus* (cou), *Piper nigrum* (cou-cat-alex), *Sambucus nigra* (cou), *Rubus fruticosus* (cou), *Sideritis montana* (cou), *Sideritis scardica* (cou), *Tilia platyphyllos* (cou), *Tussilago farfara* (cou), *Verbascum longifolium* (cou)	(Tsioutsiou et al., 2019)
	16. Svrljig region	27	*Agrimonia eupatoria* (pro-cou), *Allium cepa* (pro-cou), *Althaea officinalis* (dry-cou, pro-cou), *Bellis perennis* (pro-cou), *Crataegus monogyna* (pro-cou), *Fragaria vesca* (pro-cou), *Galium odoratum* (pro-cou), *Juniperus communis* (pro-cou), *Malus sylvestris* (pro-cou), *Marrubium vulgare* (pro-cou), *Melissa officinalis* (pro-cou), *Mentha longifolia* (cou), *Morus nigra* (pro-cou), *Ocimum basilicum* (pro-cou), *Orchis morio* (pro-cou), *Picea abies* (pro-cou), *Pinus sylvestris* (pro-cou), *Primula veris* (pro-cou), *Robinia pseudoacacia* (pro-cou), *Rosa canina* (pro-cou), *Rubus idaeus* (pro-cou), *Rubus vestitus* (pro-cou), *Rubus fruticosus* (pro-cou), *Thymus praecox* subsp. *jankae* (pro-cou), *Tilia cordata* (pro-cou), *Tussilago farfara* (pro-cou), *Viola odorata* (pro-cou)	(Matejić et al., 2020)
	17. Timok region	17	*Achillea millefolium* (pro-cou), *Glechoma hederacea* (pro-cou), *Asarum europaeum* (pro-cou), *Artemisia absinthium* (pro-cou), *Daucus carota* (pro-cou), *Melissa officinalis* (pro-cou), *Papaver rhoeas* (pro-cou), *Phaseolus vulgaris* (pro-cou), *Polygonum aviculare* (pro-cou), *Primula vulgaris* (pro-cou), *Robinia pseudoacacia* (pro-cou), *Tilia cordata* (pro-cou), *Thymus praecox* subsp. *jankae* (pro-cou), *Tropaeolum majus* (pro-cou), *Tussilago farfara* (pro-cou), *Viola odorata* (pro-cou), *Viola tricolor* (pro-cou)	(Matejić et al., 2020)
	18. Pčinja district	12	*Achillea millefolium* (cou), *Althaea officinalis* (cou), *Hedera helix* (cou), *Inula helenium* (cou), *Laurus nobilis* (cou), *Linum usitatissimum* (cou), *Matricaria chamomilla* (cou), *Mentha spicata* (cou), *Ocimum basilicum* (cou), *Plantago major* (cou), *Primula veris* (cou), *Tussilago farfara* (cou)	(Pieroni et al., 2011)
Expectorant	2. Kopaonik	14	*Althaea officinalis* (exp), *Daphne laureola* (exp), *Echium vulgare* (exp), *Inula helenium* (exp), *Juglans regia* (exp-t), *Malva sylvestris* (exp), *Origanum vulgare* (exp), *Plantago lanceolata* (exp), *Plantago major* (exp), *Plantago media* (exp), *Sambucus nigra* (exp), *Symphytum officinale* (exp), *Verbascum phlomoides* (exp), *Veronica officinalis* (exp-com)	(Jarić et al., 2007)
	3. Bosnia and Herzegovina	10	*Hypericum montanum* (exp-sc), *Hypericum perforatum* (exp-sc), *Veronica austriaca* (exp-mix), *Veronica chamaedrys* (exp-mix), *Viola arvensis* (exp-mix), *Viola biflora* (exp-mix), *Viola elegantula* (exp-mix), *Viola hirta* (exp-mix), *Viola odorata* (exp-mix), *Viola tricolor* (exp-mix)	(Šarić Kundalić et al., 2010)
	4. Prokletije Mts.	3	*Bellis perennis* (exp), *Galium odoratum* (exp), *Stachys officinalis* (exp)	(Menković et al., 2011)
	9. Rtanj Mt.	2	*Primula veris* (exp), *Taraxacum campylodes* (exp)	(Zlatković et al., 2014)
	11. South Kosovo and Metohija	6	*Mentha longifolia* (exp), *Primula veris* (exp), *Sambucus nigra* (exp), *Rubus fruticosus* (exp), *Tilia platyphyllos* (exp), *Tussilago farfara* (exp)	(Mustafa et al., 2015)
	12. Suva Planina Mts.	5	*Althaea officinalis* (exp-mac), *Primula veris* (exp-t,syr), *Salvia officinalis* (exp-syr), *Salvia verticillata* (exp), *Satureja hortensis* (exp)	(Jarić et al., 2015a)
	13. Konjuh Mts.	7	*Robinia pseudoacacia* (exp), *Rosa canina* (exp), *Salvia officinalis* (exp), *Sambucus nigra* (exp), *Symphytum officinale* (exp), *Teucrium montanum* (exp), *Verbascum* sp. (exp)	(Šarić Kundalić et al., 2016)
	15. Edessa – Naoussa	5	*Achillea holosericea* (exp), *Dactylorhiza latifolia* (exp), *Linum usitatissimum* (exp), *Malva sylvestris* (exp), *Sambucus nigra* (exp)	(Tsioutsiou et al., 2019)
Fever	2. Kopaonik Mt.	1	*Inula helenium* (hf)	(Jarić et al., 2007)
	4. Prokletije Mts.	4	*Filipendula ulmaria* (f), *Matricaria chamomilla* (f), *Nepeta cataria* (f), *Plantago lanceolata* (f)	(Menković et al., 2011)
	5. Pešter Plateau	8	*Achillea millefolium* (f), *Arctium lappa* (f), *Melissa officinalis* (f), *Prunus domestica* (f), *Pyrus communis* (f), *Pyrus pyraster* f), *Rosa canina* (f), *Thymus pulegioides* (f)	(Pieroni et al., 2011)

	6. Zlatibor district	3	*Mentha* × *piperita* (f), *Sambucus nigra* (f), *Tilia cordata* (f)	(Šavikin et al., 2013)
	7. Sharr Mts.	5	*Althaea officinalis* (f), *Morus alba* (f), *Thymus serpyllum* (f), *Tilia cordata* (f), *Verbascum phlomoides* (f)	(Rexhepi et al., 2013)
	8. Peshkopia	1	*Origanum vulgare* (f)	(Pieroni et al., 2014a)
	10. Raicë and Mokra	1	*Tilia cordata* (f)	(Pieroni et al., 2014b)
	13. Konjuh Mts.	5	*Filipendula ulmaria* (hf), *Malus domestica* (hf), *Rosa canina* (hf), *Ocimum basilicum* (hf), *Tilia* × *euchlora* (hf)	(Šarić Kundalić et al., 2016)
Headaches	2. Kopaonik Mt.	1	*Origanum vulgare* (hd)	(Jarić et al., 2007)
	5. Pešter Plateau	1	*Arctium lappa* (hd)	(Pieroni et al., 2011)
	7. Sharr Mts.	1	*Morus alba* (hd)	(Rexhepi et al., 2013)
	8. Peshkopia	1	*Origanum vulgare* (hd)	(Pieroni et al., 2014a)
	10. Raicë and Mokra	1	*Tilia cordata* (hd)	(Pieroni et al., 2014b)
	11. South Kosovo and Metohija	3	*Melissa officinalis* (hd), *Primula veris* (hd), Urtica dioica (hd)	(Pieroni et al., 2014b)
	13. Konjuh Mts.	1	*Tilia* × *euchlora* (hd)	(Šarić Kundalić et al., 2016)
Herpes	2. Kopaonik Mt.	1	*Juglans regia* (her-ex)	(Jarić et al., 2007)
	12. Suva Planina Mts.	1	*Sempervivum tectorum* (her-ot)	(Jarić et al., 2015a)
Influenza	1. Northern Albanian Alps	5	*Hypericum maculatum* (flu), *Primula veris* (flu), *Rosa canina* (flu), *Salvia officinalis* (flu), *Tilia cordata* (flu)	(Pieroni et al., 2005)
	2. Kopaonik Mt.	6	*Achillea millefolium* (flu), *Eupatorium cannabinum* (flu-li), *Mentha* × *piperita* (flu), *Rosa canina* (flu-t), *Sambucus nigra* (flu), *Verbascum phlomoides* (flu)	(Jarić et al., 2007)
	3. Bosnia and Herzegovina	11	*Castanea sativa* (flu-sc), *Filipendula ulmaria* (flu-sc, flu-mix), *Filipendula vulgaris* (flu-sc, flu-mix), *Glechoma hederacea* (flu-sc), *Glechoma hirsuta* (flu-sc), *Salvia grandiflora* (flu-sc), *Salvia officinalis* (flu-sc), *Salvia pratensis* (flu-sc), *Sambucus nigra* (flu-mix), *Tilia* × *euchlora* (flu-mix), *Tilia hybrids* (flu-mix)	(Šarić Kundalić et al., 2010)
	4. Prokletije Mts.	1	*Sambucus nigra* (flu)	(Menković et al., 2011)
	7. Sharr Mts.	5	*Althaea officinalis* (flu), *Gentiana lutea* (flu), *Ligustrum vulgare* (flu), *Thymus serpyllum* (flu), *Verbascum phlomoides* (flu)	(Rexhepi et al., 2013)
	8. Peshkopia	3	*Origanum vulgare* (flu), *Rosa canina* (flu), *Stachys tymphaea* (flu)	(Pieroni et al., 2014a)
	10. Raicë and Mokra	4	*Origanum vulgare* (flu), *Prunus domestica* (flu), *Sideritis reiseri* (flu), *Vitis labrusca* (flu)	(Pieroni et al., 2014b)
	11. South Kosovo and Metohija	8	*Achillea millefolium* (flu), *Matricaria chamomilla* (flu), *Mentha longifolia* (flu), *Orchis morio* (flu), *Origanum vulgare* (flu), *Rosa canina* (flu), *Sambucus nigra* (flu), *Urtica dioica* (flu)	(Mustafa et al., 2015)
	12. Suva Planina Mts.	1	*Malus sylvestris* (flu-vin-mix-w,h)	(Jarić et al., 2015a)
	13. Konjuh Mts.	7	*Filipendula ulmaria* (flu), *Matricaria chamomilla* (flu), *Pulmonaria officinalis* (flu), *Rosa canina* (flu), *Sambucus nigra* (flu), *Tilia* × *euchlora* (flu), *Vaccinium vitis-idaea* (flu)	(Šarić Kundalić et al., 2016)
	15. Edessa – Naoussa	1	*Crocus sativus* (flu-prev)	(Tsioutsiou et al., 2019)
Laryngitis	2. Kopaonik Mt.	1	*Verbascum phlomoides* (lar)	(Jarić et al., 2007)
	11. South Kosovo and Metohija	1	*Geranium sanguineum* (lar)	(Mustafa et al., 2015)
	12. Suva Planina Mts.	3	*Agrimonia eupatoria* (lar-t), *Matricaria chamomilla* (lar-t), *Prunus avium* (lar-t)	(Jarić et al., 2015a)
Lung ailments	2. Kopaonik Mt	2	*Alcea rosea* (ca), *Malva sylvestris* (la)	(Jarić et al., 2007)

	3. Bosnia and Herzegovina	25	*Allium cepa* (pa-sc), *Allium ursinum* (pa-sc), *Anchusa officinalis* (pa-mix), *Angelica archangelica* (pn-sc), *Glechoma hederacea* (pa-sc), *Cupressocyparis leinaldii* (pa-sc), *Ficus carica* (pa-mix-dec), *Hordeum vulgare* (pa-mix), *Hypericum montanum* (pa-mix), *Hypericum perforatum* (pa-mix), *Hypericum tetrapterum* (pa-mix), *Malva moschata* (pa-mix), *Malva sylvestris* (pa-mix), *Pilosella officinarum* (pa-sc), *Pimpinella anisum* (pa-mix), *Pinus heldreichii* (pa-sc), *Pinus mugo* (pa-sc), *Pinus nigra* (pa-sc), *Pinus sylvestris* (pa-sc), *Plantago lanceolata* (pa-mix), *Plantago major* (pa-mix), *Plantago media* (pa-mix), *Pulmonaria officinalis* (pa-mix), *Symphytum officinale* (pa-mix), *Thuja occidentalis* (pa-sc)	(Šarić Kundalić et al., 2010)
	12. Suva Planina Mts.	7	*Allium sativum* (pn), *Hyssopus officinalis* (pp), *Lamium galeobdolon* (pd), *Lavandula officinalis* (pp), *Origanum vulgare* (pd), *Pulmonaria officinalis* (pp-t), *Sambucus nigra* (pd)	(Jarić et al., 2015a)
	13. Konjuh Mts.	14	*Allium cepa* (pa), *Allium sativum* (ppur), *Equisetum arvense* (pa), *Hypericum perforatum* (pa), *Juglans regia* (pn), *Juniperus communis* (cp, pn), *Malus domestica* (pa), *Plantago lanceolata* (pa), *Plantago major* (pa), *Polygonum aviculare* (pa), *Primula vulgaris* (pa), *Pulmonaria officinalis* (pa), *Symphytum officinale* (pn), *Urtica dioica* (pa)	(Šarić Kundalić et al., 2016)
	14. Negotin Krajina	7	*Quercus petraea* (pn), *Majorana hortensis* (pn), *Pinus sylvestris* (pn), *Plantago major* (pn), *Primula vulgaris* (pn), *Tilia tomentosa* (pn), *Urtica dioica* (pn)	(Janaćković et al., 2019)
Moucilaginous	2. Kopaonik Mt.	2	*Althaea officinalis* (mou), *Malva sylvestris* (mou)	(Jarić et al., 2007)
	12. Suva Planina Mts.		*Verbascum* sp. (cou-muc)	(Jarić et al., 2015a)
	14. Negotin Krajina		*Althaea officinalis* (h-s-ro)	(Janaćković et al., 2019)
Mouth and throat infections	1. Northern Albanian Alps	1	*Salvia officinalis* (ton)	(Pieroni et al., 2005)
	2. Kopaonik Mt.	3	*Malva sylvestris* (ti), *Pimpinella saxifraga* (mti), *Verbena officinalis* (g-mti), *Viola tricolor* (g-mti)	(Jarić et al., 2007)
	3. Bosnia and Herzegovina	15	*Achillea collina* (ta-mix), *Achillea nobilis* (ta-mix), *Althaea officinalis* (t-infc-sc), *Arctium lappa* (m-infc-sc), *Frangula dodonei* (t-infm-sc), *Matricaria chamomilla* (ta-mix, t-infm-mix), *Pimpinella major* (ta-mix), *Potentilla erecta* (ta-mix), *Potentilla recta* (ta-mix), *Potentilla reptans* (ta-mix), *Prunella vulgaris* (t-infm-mix), *Rubus fruticosus* (t-infm-mix), *Salvia grandiflora* (ta-mix, t-infm-mix), *Salvia officinalis* (ta-mix, t-infm), *Salvia pratensis* (ta-mix, t-infm)	(Šarić Kundalić et al., 2010)
	4. Prokletije Mts.	6	*Agrimonia eupatoria* (mf-infm-ex), *Ajuga reptans* (mf-infm-ex), *Alnus glutinosa* (mf-infm-ex), *Potentilla erecta* (mf-infm-ex), *Rubus idaeus* (mf-infm-ex), *Vaccinium myrtillus* (mt-infm)	(Menković et al., 2011)
	6. Zlatibor district	1	*Salvia officinalis* (ti)	(Šavikin et al., 2013)
	11. South Kosovo and Metohija	11	*Matricaria chamomilla* (or-cav-i), *Rubus fruticosus* (or-cav-i), *Salvia officinalis* (ton)	(Mustafa et al., 2015)
	12. Suva Planina Mts.	1	*Quercus cerris* (g-t),	(Jarić et al., 2015a)
	13. Konjuh Mts.	17	*Alchemilla vulgaris* (t-infm-ex), *Allium sativum* (t-infm), *Citrus* × *limon* (ta), *Hypericum perforatum* (t-infm), *Juglans regia* (t-infm), *Juniperus communis* (t-infm), *Matricaria chamomilla* (t-infm), *Mentha* × *piperita* (t-infm), *Plantago lanceolata* (t-infm), *Plantago major* (t-infm), *Prunus avium* (ton), *Quercus pubescens* (t-infm), *Quercus robur* (t-infm), *Rubus idaeus* (t-infm), *Salvia officinalis* (t-infm), *Sambucus nigra* (ton), *Sempervivum hirtum* (t-infm)	(Šarić Kundalić et al., 2016)
	14. Negotin Krajina	1	*Salvia officinalis* (f-t-i)	(Janaćković et al., 2019)
	18. Pčinja district	1	*Salvia officinalis* (mt-w)	(Pieroni et al., 2011)
Respiratory infections	1. Northern Albanian Alps	1	*Asplenium scolopendrium* (r-infc)	(Pieroni et al., 2005)
	2. Kopaonik Mt.	1	*Teucrium montanum* (ra-t)	(Jarić et al., 2007)
	4. Prokletije Mts.	10	*Abies alba* (cat), *Alcea rosea* (rp), *Astrantia major* (rtc), *Origanum vulgare* (rd), *Petasites hybridus* (rd), *Plantago major* (rd), *Plantago media* (rd), *Teucrium montanum* (rd), *Thymus pulegioides* (rd), *Tussilago farfara* (cat-cou), *Verbascum densiflorum* (cat), *Verbascum phlomoides* (cat), *Verbascum thapsus* (cat)	(Menković et al., 2011)

	6. Zlatibor district	1	*Melissa officinalis* (ri-vir), *Thymus serpyllum* (rd)	(Šavikin et al., 2013)
	7. Sharr Mts.	16	*Althaea officinalis* (rp), *Capsella bursa-pastoris* (rp), *Gentiana lutea* (rp), *Ligustrum vulgare* (rp), *Malva sylvestris* (rp), *Mentha longifolia* (rp), *Mentha* × *piperita* (rp), *Origanum vulgare* (rp), *Prunella vulgaris* (vi-tea-gar), *Rosa canina* (rp), *Saponaria officinalis* (rp), *Juniperus communis* (rp), *Thymus serpyllum* (rp), *Tilia cordata* (rp), *Vaccinium myrtillus* (vi-tea-gar), *Verbascum phlomoides* (rp)	(Rexhepi et al., 2013)
	11. South Kosovo and Metohija	16	*Allium sativum* (rsd), *Centaurea cyanus* (rsd), *Elymus repens* (rsd), *Geranium sanguineum* (rsd), *Melissa officinalis* (rsd), *Mentha longifolia* (r-infc), *Mentha pulegium* (r-infc), *Morus nigra* (r-infc), *Origanum vulgare* (r-infc), *Primula veris* (rsd), *Salvia officinalis* (r-infc), *Rubus fruticosus* (r-infc), *Tilia latifolia* (r-infm), *Tilia platyphyllos* (r-infm), *Vaccinium myrtillus* (r-infm), *Veronica officinalis* (r-infm)	(Mustafa et al., 2015)
	12. Suva Planina Mts.	4	*Achillea millefolium* (rp), *Mentha spicata* (rc), *Rubus fruticosus* (rp), *Viola odorata* (rd)	(Jarić et al., 2015a)
	13. Konjuh Mts.	8	*Abies alba* (rsd), *Achillea nobilis* (rsd), *Allium ursinum* (rsd), *Capsella bursa-pastoris* (rsd), *Elymus repens* (rsd), *Glechoma hederacea* (rsd), *Matricaria chamomilla* (rsd), *Tilia* × *euchlora* (ra)	(Šarić Kundalić et al., 2016)
	14. Negotin Krajina	1	*Pinus nigra* (in-ro)	(Janaćković et al., 2019)
	15. Edessa – Naoussa	10	*Achillea holosericea* (r-infm), *Arum italicum* (br-cat), *Arum maculatum* (br-cat), *Mentha* sp. (r-infm), *Sambucus nigra* (r-infm), *Rubus fruticosus* (r-infm), *Sideritis montana* (r-infm), *Sideritis scardica* (r-infm), *Tilia platyphyllos* (br-cat), *Tussilago farfara* (r-infm)	(Tsioutsiou et al., 2019)
	18. Pčinja district	7	*Crataegus monogyna* (rc), *Equisetum arvense* (rc), *Pinus sylvestris* (rd), *Pulmonaria officinalis* (rd), *Taraxacum campylodes* (rp), *Thymus vulgare* (rd), *Urtica dioica* (rp)	(Pieroni et al., 2011)
Sore throat	1. Northern Albanian Alps	3	*Hypericum maculatum* (st), *Salvia officinalis* (st), *Tilia cordata* (st)	(Pieroni et al., 2005)
	2. Kopaonik Mt.	2	*Alcea rosea* (st-ex), *Foeniculum vulgare* (g-st)	(Jarić et al., 2007)
	5. Pešter Plateau	11	*Achillea millefolium* (st), *Castanea sativa* (st), *Corylus avellana* (st), *Crataegus monogyna* (st), *Matricaria chamomilla* (st), *Melissa officinalis* (st), *Origanum vulgare* (st), *Prunus domestica* (st), *Pyrus communis* (st), *Pyrus pyraster* (st), *Rosa canina* (st)	(Pieroni et al., 2011)
	7. Sharr Mts.	1	*Sideritis scardica* (st-vi)	(Rexhepi et al., 2013)
	8. Peshkopia	6	*Allium sativum* (st), *Hypericum perforatum* (st), *Juglans regia* (st), *Origanum vulgare* (st), *Prunus cerasifera* (drunk-st-fd), *Prunus domestica* (drunk-st-fd), *Rosa canina* (st)	(Pieroni et al., 2014a)
	9. Rtanj Mt.	1	*Rubus ulmifolius* (st)	(Zlatković et al., 2014)
	14. Negotin Krajina	3	*Majorana hortensis* (st), *Prunus avium* (st), *Tilia tomentosa* (st)	(Janaćković et al., 2019)
	15. Edessa – Naoussa	2	*Arum italicum* (st), *Arum maculatum* (st)	(Tsioutsiou et al., 2019)
	16. Svrljig region	8	*Achillea millefolium* (ph), *Anagallis arvensis* (ph), *Hyacinthus orientalis* (ph), *Matricaria chamomilla* (ph), *Ocimum basilicum* (ph), *Rosa canina* (ph), *Salvia officinalis* (ph), *Symphytum officinale* (ph)	(Matejić et al., 2020)
	17. Timok region	1	*Trifolium pratense* (ph)	(Matejić et al., 2020)
Sinusitis	2. Kopaonik Mt.	1	*Juniperus communis* (inh), *Matricaria chamomilla* (inh-sin)	(Jarić et al., 2007)
	4. Prokletije	1	*Pinus mugo* (inh)	(Menković et al., 2011)
	5. Pešter Plateau	4	*Prunus domestica* (sin), *Pyrus communis* (sin), *Pyrus pyraster* (sin), *Tanacetum balsamita* (sin)	(Pieroni et al., 2011)
	12. Suva Planina Mts.	2	*Mentha pulegium* (inh), *Ocimum basilicum* (inh-cbt)	(Jarić et al., 2015a)
	16. Svrljig region	2	*Mentha aquatica* (sin), *Ocimum basilicum* (sin)	(Matejić et al., 2020)
	17. Timok region		*Glechoma hederacea* (sin)	(Matejić et al., 2020)
	18. Pčinja district		*Ocimum basilicum* (inh), *Zingiber officinale* (sd)	(Pieroni et al., 2011)
Tonic effects on	2. Kopaonik Mt.	1	*Glechoma hederacea* (te-bs)	(Jarić et al., 2007)

the bronchial system				
Tuberculosis	2. Kopaonik Mt.	2	*Inula helenium* (tub), *Verbascum phlomoides* (tub-t)	(Jarić et al., 2007)
	3. Bosnia and Herzegovina	2	*Allium cepa* (tub-sc), *Glechoma hederacea* (tub-sc), *Glechoma hirsuta* (tub-sc)	(Šarić Kundalić et al., 2010)
	7. Sharr Mts.	2	*Juniperus communis* (tub-prev), *Verbascum phlomoides* (tub-prev)	(Rexhepi et al., 2013)
	11. South Kosovo and Metohija	6	*Juniperus communis* (tub), *Ocimum basilicum* (tub), *Olea europaea* (tub), *Rubia tinctorum* (tub), *Teucrium polium* (tub), *Ulmus minor* (tub)	(Mustafa et al., 2015)
	12. Suva Planina Mts.	1	*Teucrium montanum* (tub)	(Jarić et al., 2015a)
	13. Konjuh Mts.	7	*Allium sativum* (tub), *Brassica rapa* (tub), *Ocimum basilicum* (tub), *Plantago lanceolata* (tub), *Plantago major* (tub), *Quercus robur* (tub), *Verbascum* sp. (tub)	(Šarić Kundalić et al., 2016)
	16. Svrljig region	3	*Inula helenium* (tub), *Pulmonaria officinalis* (tub), *Quercus robur* (tub)	(Matejić et al., 2020)
	17. Timok region	1	*Teucrium chamaedrys* (tub)	(Matejić et al., 2020)

Applications: Antitussive: antitussive (anti-tus); Asthma: antiasthmatic (anti-a), asthma (a), asthma – in mixture (a-mix), asthma – in mixture – decect (a-mix-dec), asthma – single component (a-sc), bronchial asthma (ba); Bronchitis: bronchitis (b), bronchitis – decoction (b-dec), bronchitis – for children (b-ch), bronchitis in mixtures (b-mix), chronicaly bronchitis (cb); Cold: cold (col), cold – externally (col-ex), cold – tea (col-t), common cold (ccol), common cold in mixtures (ccol-mix), common cold – single component (ccol-sc), fatigue after cold (fat-aft-col), prevention of common cold (ccol-prev); Cough: coughs (cou), controls coughing (con-cou), cough – cataplasm – alcoholic extract (cou-cat-alex), coughs in mixtures (cou-mix), coughs in mixtures – syrup (cou-mix-syr), cough – single component (cou-sc), cough-inhalation (cou-inh), coughs – juice mixed with honey (cou-j-mix-h), coughs – syrup and tae (cou-syr,t), dry couh (dry-cou), dry couh – in mixtures (dry-cou-mix), dry couh – single component (dry-cou-sc), persistent coughs (per-cou), pertussis (p), productive cough (pro-cou), spasmodic cough (spasm-cou), soothing coughs – tea (sot-cou-t), unspecific cough (unspec-cou), whooping cough (w-cou); whooping cough in children (w-cou-ch); Expectorant: expectorant (exp), expectorant – maceration (exp-mac), expectorant – syrup (exp-syr), expectorant – tea (exp-t), expectorant – tea, syrup (exp-t,syr), expectorant – combined with other herbs (exp-com), expectorant – in mixtures (exp-mix), expectorant – single component (exp-sc); Fever: fever (f), hay fever (hf); Headaches: headaches (hd); Herpes: herpes – externally (her-ex), herpes – otitis (her-ot); Influenza: influenza (flu), treatment for influenza-like illnesses (flu-li), influenza – in mixtures (flu-mix), influenza – single component (flu-sc), prevention of influenza (flu-prev), influenza – tea (flu-t), influenza – vinegar mixed with water and honey (flu-vin-mix-w,h); Laryngitis: laryngitis (lar), laryngitis- tea (lar-t); Lung ailments: chest ailments (ca), chest pain (cp), lung ailments (la), pneumonia (pn), pneumonia – single component (pn-sc), pulmonary ailments (pa), pulmonary ailments – in mixtures (pa-mix), pulmonary ailments – in mixtures – decoct (pa-mix-dec), pulmonary ailments – single component (pa-sc), pulmonary diseases (pd), pulmonary problems (pp), pulmonary problems – tea (pp-t), pulmonary purification (ppur); Moucilaginous: aids the coughing up of mucus – tea (cou-muc), moucilaginous (mou), help secretion from the respiratory organs (h-s-ro); Mouth and throat infections: gargle of the throat (g-t), gargle with tea for mouth and throat infections (g-mti), flushing throat during inflammation (f-t-i), inflammation of mouth and pharynx – externally (mf-infm-ex), inflammation of mouth and throat (mt-infm), mouth and throat infections (mti), mouth infections – single component (m-infc-sc), mouth and throath wash (mt-w), oral cavity infections (or-cav-i), throat ache (ta), throat ache – in mixtures (ta-mix), throat infections (ti), throat infection – single component (t-infc-sc), throat inflammation (t-infm), throat inflammation – externally (t-infm-ex), throat inflammation – in mixtures (t-infm-mix), throat inflammation – single component (t-infm-sc), tonsillitis (ton); Respiratory infections: against viral infections – tea in gargles (vi-tea-gar), bronchial catarrh (br-cat), catarrh of the respiratory tract (cat), catarrh of the respiratory tract with cough (cat-cou), inflammation of the respiratory organs (in-ro), respiratory ailments (ra), respiratory ailmenst – tea (ra-t), respiratory complaints (rc), respiratory disorders (rd), respiratory infections (r-infc), respiratory infections caused by viruses (ri-vir), respiratory inflammations (r-infm), respiratory problems (rp), respiratory system disorders (rsd), respiratory problems (rp), respiratory tract complaints (rtc); Sinusitis: inhalation (inh), inhalation – clear the bronchial tube (inh-cbt), inhalation for sinusitis (inh-sin), sinus disorders (sd), sinusitis (sin); Sore throat: gargle for sore throats (g-st), drunk for sore throat – fermented and destiled (drunk-st-fd), pharyngitis (ph), sore throat – externally (st-ex), sore throat – viral infections (st-vi); Tonic effects on the bronchial system: tonic effects on the bronchial system (te-bs); Tuberculosis: to prevent from tuberculosis (tub-prev), tuberculosis (tub), tuberculosis – single component (tub-sc), tuberculosis – tea (tub-t).

Tussilago farfara

Coltsfoot (*Tussilago farfara*) is a common species widely used in traditional European medicine to treat respiratory system diseases. However, the raw material studies from this plant showed that it contains hepatotoxic pyrrolizidine alkaloids (Adamczak et al., 2013). Dragicević et al. (2019) have studied the evaluation of toxicity of *Tussilago farfara* water extracts in bronchial epithelial cells. Their results showed that *T. farfara* water leaf extract is potentially safe and beneficial in treating respiratory disorders such as asthma and suggested that its actions result from its antioxidative effects on bronchial epithelial cells.

The folk medical heritage about the use of *Tussilago farfara* among the Serbian population against respiratory infections includes the following applications: cough (Živković et al., 2020; Pieroni et al., 2011; Šavikin et al., 2013), a persistent cough (Jarić et al., 2015a), productive cough, and asthma (Matejić et al., 2020), and bronchitis (Živković et al., 2020).

The ethnomedicinal uses of *Tussilago farfara*, mentioned among the people of other Balkan countries against respiratory infections, include the following applications: coughs (Pieroni et al., 2014b; Tsioutsiou et al., 2019), asthma (Šarić Kundalić et al., 2010; 2016), common cold and dry cough (Jarić et al., 2007), bronchitis (Šarić Kundalić et al., 2010), catarrh of the respiratory tract with cough (Menković et al., 2011), expectorant, antitussive (Mustafa et al., 2015), inflammation of the respiratory tract (Tsioutsiou et al., 2019).

Plantago major

The leaves of *Plantago major* have been used in the treatment of several diseases. These include disorders related to respiratory organs and against infections due to biologically active ingredients (Samuelsen, 2000). Experimental studies have confirmed a spastic effect on the smooth musculature of bronchi. The preparation with leaves of *Plantago major*, applied on patients with chronic bronchitis, was with good tolerance, with no toxic effect on the gastrointestinal tract, liver, and kidneys (Matev et al., 1982).

Broadleaf plantain (*Plantago major*) grows in Serbia at meadows, fields, and roadsides. The medicinal uses of *Plantago major* in the treatment of respiratory infections among the Serbian population were: antitussive, expectorant (Jarić et al., 2007), cough (Živković et al., 2020; Janaćković et al., 2019; Jarić et al., 2015a; Pieroni et al., 2011; Šavikin et al., 2013), bronchitis (Živković et al., 2020; Matejić et al., 2020; Šavikin et al., 2013; Zlatković et al., 2014), and pneumonia (Janaćković et al., 2019). *Plantago lanceolata* was mentioned as antitussive and expectorant (Jarić et al., 2007), against cough and bronchitis (Šavikin et al., 2013), and cough – in the juice mixed with honey (Jarić et al., 2015a). *P. major* contains biologically active compounds such as polysaccharides, lipids, caffeic acid derivatives, flavonoids, iridoid glycosides, and terpenoids. Alkaloids and some organic acids have also been detected. A range of biological activities has been found from plant extracts including wound healing activity, anti-inflammatory, analgesic, antioxidant, weak antibiotic, immunomodulating, and antiulcerogenic activity. Some of these effects may attribute to the use of this plant in folk medicine (Samuelsen, 2000). It contained the highest concentrations of total phenolics, compared with all investigated species of the genus *Plantago* (Janković et al., 2012).

Rosa canina

Dog rose (*Rosa canina*) exhibits many pharmacological activities, making it helpful in protecting against or treating several diseases. Jarić et al. (2014) have shown that dog rose is extensively used as a herbal remedy in the Western Balkans, including Serbia, particularly in treating respiratory complaints. According to Hamidi et al. (2015), *Rosa canina* is a potent anti-inflammatory remedy that can be used to treat asthma, thanks to the content of many well-known antioxidants, including vitamin C, quercetin, hesperidin, rutin, and some other therapeutic compounds.

The ethnomedicinal uses of *Rosa canina* against respiratory system diseases among the Serbian population include the following applications: colds (Jarić et al., 2015a; 2007; Pieroni et al., 2011; Šavikin et al., 2013), influenza (tea) (Jarić et al., 2007), fever and sore throat (Pieroni et al., 2011), cough (Jarić et al., 2015a; Pieroni et al., 2011), pharyngitis and productive cough (Matejić et al., 2020). The people of Pirot County (Southeastern Serbia) take the fruit, named rose hip, usually as a vitamin C source to prevent and treat colds, influenza, and vitamin C deficiencies or disease prevention instead of coffee (Marković et al., 2020b). According to Marković (2019) on the Vidlič Mountain in the Pirot County, *R. canina* was noticed in the brush-woods and thermophilous forests subspecies *R. canina* L. subsp. *lutetiana* (Lém.) Hay and *R. canina* L. subsp. *dumalis* Baker.

The ethnomedicinal uses of *Rosa canina* mentioned against respiratory infections among the people of other Balkan countries includes the following applications: influenza (Menković et al., 2011; Mustafa et al., 2015; Pieroni et al., 2005; Šarić Kundalić et al., 2016) respiratory problems (bronchitis, cold), sore throat (Pieroni et al., 2014a), cough (Pieroni et al., 2014b), high fever and expectorant (Šarić Kundalić et al., 2016).

Sambucus nigra

Since ancient times, elderberry (*Sambucus nigra*) has been used in traditional medicine. Supplementation with flowers of elderberry was found to reduce respiratory infection symptoms substantially. It represents an alternative to antibiotic abuse for upper respiratory system symptoms caused by viral infections and a prospective safer alternative to prescription drugs for common cold and flu cases (Hawkins et al., 2019). Evidence collected in clinical studies suggests that herbal preparations of *Sambucus nigra* berry, when taken within 48 hours of the onset of an acute respiratory viral infection, may reduce the duration and severity of cold and flu symptoms in adults (Harnett et al., 2020). Although elderberry is a widespread species on the Balkan Peninsula, it is not sufficiently exploited and is poorly chemically and biologically characterized (Vujanović et al., 2019).

The ethnomedicinal uses of *Sambucus nigra* against respiratory infections among the Serbian population were: colds (Jarić et al., 2015a; 2007; Šavikin et al., 2013), influenza (Jarić et al., 2007), expectorant and for pertussis (Jarić et al., 2007), bronchitis (Pieroni et al., 2011; Zlatković et al., 2014), fever (Šavikin et al., 2013), pulmonary disease in general and coughs (Jarić et al., 2015a).

The folk medical heritage about use of *Sambucus nigra*, among other Balkan territories against respiratory infections, includes the following applications: influenza (Mustafa et al., 2015; Pieroni et al., 2011; Šarić Kundalić et al., 2010; 2016) cold and common cold (Šarić Kundalić et al., 2010) , antitussive (Mustafa et al., 2015; Rexhepi et al., 2013), bronchitis (Mustafa et al., 2015; Šarić Kundalić et al., 2016), expectorant (Mustafa et al., 2015; Tsioutsiou et al., 2019; Šarić Kundalić et al., 2016), anti-asthmatic (Mustafa et al., 2015) cough (Tsioutsiou et al., 2019; Šarić Kundalić et al., 2016), tonsillitis (Šarić Kundalić et al., 2016), and inflammation of the respiratory tract (Tsioutsiou et al., 2019).

Althaea officinalis

The root of marshmallow (*Althaea officinalis* L.) has been used in traditional herbal medicine, including treating minor respiratory ailments and using it as a gargle against mouth and

throat infections. The medicinal effect of *Althaea officinalis* on respiratory infections is reflected in the formation of a protective coating on the respiratory traction mucosal lining (Basch et al., 2003). The study of Sutovska et al. (2007) revealed that the tested polysaccharides from *Althaea officinalis* exhibited cough-suppressing activity, which was higher than that of the non-narcotic drug used in clinical practice to treat coughing. Polysaccharides from marshmallows in the same study contained the highest proportion of the uronic acid constituent. The studies confirmed the efficacy of *A. officinalis* extracts as a single component in the treatment of dry cough. In contrast, the combination of *A. officinalis* with *Zataria multiflora*, *Zingiber officinalis*, or *Hedera helix* increased the efficacy of *A. officinalis* and improved all kinds of cough (Mahboubi, 2019). According to the same author, *A. officinalis*, combined with other plant extracts in different forms of the drug, could be a good choice for cough, sore throat, and other respiratory ailments.

The use of *Althaea officinalis* among the Serbian population against respiratory infections include the following applications: antitussive, mucilaginous, asthma, whooping cough (Jarić et al., 2007), bronchitis (Jarić et al., 2007; Matejić et al., 2020), expectorant (Jarić et al., 2007; Zlatković et al., 2014), cough (Živković et al., 2020; Janaćković et al., 2019; Šavikin et al., 2013), help secretion from the respiratory organs (Jarić et al., 2015a), dry cough and productive cough (Matejić et al., 2020).

Thymus sp.

Plants from the genus *Thymus* are very polymorphous, represented in Serbia with 30 species and many subspecies, varieties, and forms (Marković et al., 2020c). According to Zarzuelo and Crespo (2002) species from the genus *Thymus* have been used since ancient times to treat respiratory systems' diseases. Thyme was used to treat asthma and loosen congestion in the throat (Jarić et al., 2015b), in the treatments of headaches caused by colds, laryngitis, and antitussive (Jarić et al., 2014). The essential oil of thyme represents a vital natural resource for the pharmaceutical industry, besides its antioxidant and antimicrobial properties and some cytotoxic effects (Nikolić et al., 2019). Given the importance of thyme as a proper antibacterial remedy, Ilić et al. (2017) have evaluated the antibacterial and streptomycin-modifying activity of *Thymus glabrescens* essential oil its components geraniol, geranyl acetate, and thymol. This study could serve as a guide for the development of intelligent and controlled pharmacomodulation of antibiotics.

In ethnobotanical studies conducted among the Serbian population, it was reported that *Thymus serpyllum* was used in the treatment of respiratory disorders in general (Šavikin et al., 2013), cough (Jarić et al., 2015a), cough and bronchitis (Živković et al., 2020). *Thymus praecox* subsp. *jankae* was used in the treatment of cold (Zlatković et al., 2014). Productive cough and bronchitis (Matejić et al., 2020), *Thymus pulegioides* were used against cold, cough, and fever (Pieroni et al., 2011) and *Thymus vulgaris* was used in the treatment of respiratory disorders in general (Živković et al., 2020). Pirot County (Marković et al., 2020c) has determined the following plant taxa from the genus *Thymus*: *Thymus longicaulis* C. Presl., *Thymus praecox* Opiz. subsp. *jankae* (Čelak) Jalas, *Thymus praecox* Opiz. subsp. *polytrichus* (A. Kern. ex Borbas), *Thymus pulegioides* L. subsp. *panonicus* (All.) Kerguélen, *Thymus pulegioides* L. subsp. *pulegioides*, *Thymus odoratissimus* Mill. and *Thymus striatus* Vahl. The same authors reported that the informants in Pirot County do not know the morphological differences between the different species from the genus *Thymus* observed in the study area of the Pirot County, and their use can be interpreted identically. The use of mentioned species in the folk medicine of the Pirot County included the following applications in the treatment of respiratory infections, said by informants: cold, cough, sore throat, lung disease, bronchitis, and respiratory diseases in general.

Since species of the genus *Thymus* are highly polymorphic regarding essential oil composition, its profiling is very important. Headspace analysis of essential oils from the aboveground parts of *Thymus glabrescens* (*Thymus odoratissimus*), *T. praecox* subsp. *jankae* and *T. pulegoides* from Serbia and Bulgaria were made by Stojanović et al. (2014). Natural bioactive compounds from *Thymus serpyllum* possess antioxidant, antimicrobial, antispasmodic, and stimulant properties (Jovanović et al., 2016). Heat- and ultrasound-assisted extraction is a well-established method in the processing of plant material, particularly for extraction of bioactive substances such as polyphenols, and the influential factors including extraction time, solid: solvent ratio, and particle size have been studied to optimize the extraction process (Jovanović et al., 2017; 2016).

Primula veris

Cowslip (*Primula veris*) has been traditionally used for treatments of cough and other respiratory problems. The cowslip roots are used as an expectorant (Lupitu et al., 2018). The flowers of the same species are ingredients in German formula BNO 1016, known by the trade name Sinupret®. Josef Popp created the herbal formula of this remedy in 1933: 23 % flowering tops of vervain - *Verbena officinalis*, 23 % flower of cowslip – *Primula veris*, 23 % flower of black elder – *Sambucus nigra*, 23 % leaf of the yellow dock – *Rumex* sp., and 8 % root of yellow gentian – *Gentiana lutea*. This formulation has been fairly extensively studied since its creation, and numerous clinical trials have demonstrated its efficacy in patients with respiratory infections caused by viruses (Yarnell, 2018).

The ethnomedicinal uses of cowslip (*Primula veris*) in the treatment of respiratory infections among the Serbian population were: cough (Živković et al., 2020; Pieroni et al., 2011; Šavikin et al., 2013), and productive cough (Matejić et al., 2020), asthma (Pieroni et al., 2011), bronchitis (Jarić et al., 2007; Šavikin et al., 2013), expectorant (Jarić et al., 2007; Zlatković et al., 2014), and colds (Jarić et al., 2015a).

Salvia officinalis

Sage (*Salvia officinalis*) is native to the Middle East and Mediterranean areas, but today it has been naturalized worldwide (Ghorbani and Esmaeilizadeh, 2017). In folk medicine, *S. officinalis* has been used to treat different kinds of disorders, including respiratory system diseases. Essential oils of 25 indigenous populations of Dalmatian sage (*Salvia officinalis*) that represent nearly half of the native distribution area of the species were analyzed by Jug-Dujaković et al. (2012). Taking into account the different chemical composition of the sage essential oil, its use for medicinal purposes must be prescribed with extreme caution. Sage oil contains well-known convulsant substances such as thujone, camphor, and cineole in different proportions (Halicioglu et al., 2011). According to the same author, although it is widely believed that herbal products benefit health, the oil of sage can result in serious adverse effects, such as epileptic seizures, especially in particularly susceptible children.

The use of *Salvia officinalis* among the Serbian population against respiratory infections includes the following applications: throat infections (Šavikin et al., 2013), colds (Živković et al., 2020; Jarić et al., 2015a), coughs, and expectorant (in the form of syrup) (Jarić et al., 2015a), flushing throat during inflammation (Janaćković et al., 2019), pharyngitis (Matejić et al., 2020) and mouth and throat wash (Živković et al., 2020).

Achillea millefolium

Yarrow (*Achillea millefolium*) is well-known medicinal plant worldwide with a long history of use in traditional medicine, with different pharmaceutical uses. It is prescribed in treating respiratory problems such as cough, influenza, and pneumonia (Akram, 2013). The results of Khan and Gilani (2010) indicate that *Achillea millefolium* exhibits bronchodilatory effects, thus explaining its medicinal use in respiratory disorders, such as asthma. The antibacterial activity of essential oils from *Achillea* species was evaluated by chemometric methods on isolated bacterial strains, suggesting that the minor compounds (oxygenated sesquiterpenes and sesquiterpenes hydrocarbons) or their combination were possibly responsible for the complete antibacterial activity of essential oils (Miladinović et al., 2021).
Yarrow is one of the most frequently used medicinal plants in Serbia (Pljevljakušić et al., 2017). The ethnomedicinal uses of *Achillea millefolium* in the treatment of respiratory infections among the Serbian population were: colds (Živković et al., 2020), influenza (Jarić et al., 2007), coughs (Živković et al., 2020; Jarić et al., 2007; Pieroni et al., 2011; Šavikin et al., 2013), bronchial asthma (Jarić et al., 2007); sore throat and fever (Pieroni et al., 2011), respiratory problems in general (Jarić et al., 2015a); bronchitis and pharyngitis (Matejić et al., 2020). It was noticed that yarrow is one of ten best known medicinal plant species in the Pirot County (Southeastern Serbia), and its ethnomedicinal applications against respiratory infections were: common cold, cough, sore throat, pulmonary disease, bronchitis, chest pain, influenza, and sinusitis (Marković et al., 2019).

Ocimum basilicum

Sweet basil (*Ocimum basilicum*) has been traditionally used to treat several diseases, including respiratory infections and tuberculosis symptoms. Inhibition of *Mycobacterium tuberculosis* by pure compounds from basil supports this plant's use in ethnomedicine for the treatment symptoms of tuberculosis (Siddiqui et al., 2012). According to the same authors, basil is a potential candidate for obtaining new antituberculosis natural products. Sweet basil contains different alkylbenzenes, characterized by a genotoxic or carcinogenic profile. Due to the protective effect and its flavonoid content, *Ocimum basilicum* does not represent a risk for human health (Al Abbasy et al., 2015). According to the same authors, the essential oil of *O. basilicum* showed moderate activity against Gram-negative bacteria and excellent antibacterial activity against Gram-positive bacteria. Plants for Lamiaceae families contain different coumarins that are known to have antimicrobial effects (Veselinović et al., 2014).
The ethnomedicinal uses of basil (*Ocimum basilicum*) among the Serbian population against respiratory infections include cough (Živković et al., 2020; Šavikin et al., 2013), inhalation (clear the bronchial tubes) (Živković et al., 2020; Jarić et al., 2015a; Šavikin et al., 2013), colds (in the form of tea) (Jarić et al., 2015a), productive cough, sinusitis, and pharyngitis (Matejić et al., 2020), and asthma (Živković et al., 2020; Matejić et al., 2020).

Tilia cordata

Tea preparations of *Tilia cordata* flowers and bracts alleviated symptoms of the respiratory tract and throat infections. The study of Ismail and Nawas (2019) aimed at determining whether *Tilia cordata* was capable of inhibiting the growth of various local clinical bacterial isolates, with a particular interest in those that commonly caused respiratory tract infections, showing active ingredients of *Tilia cordata*, can prove to be potent antibacterial agents since it has proven to be able to inhibit the growth of many significant bacteria, that are multiresistant to available antibacterial medicaments against respiratory infections. Besides, considering the phytoncide content detected in *T. cordata* leaves, this species has a high potential for human health improvement within Forest therapy (Zorić et al., 2020). In the mentioned study, the composition of volatile organic compounds, determined in *Tilia cordata*, showed organic compounds, which have previously been described as anti-viral agents. Therefore this method can be potentially used for novel coronavirus treatment.
The ethnomedicinal uses of *Tilia cordata* among the Serbian population against respiratory infections include: fever (Šavikin et al., 2013), cold (Jarić et al., 2015a; Šavikin et al., 2013; Zlatković et al., 2014), coughs (Jarić et al., 2015a), productive cough, and bronchitis (Matejić et al., 2020).

Verbascum sp.

It is worth noting the use of species from the genus *Verbascum* in the treatment of respiratory infections. *Verbascum* species' flowers are used in the treatment of inflammation, asthma, spasmodic coughs, and other respiratory tract diseases, and their phenolic constituents are considered to be responsible for their anti-inflammatory and antimicrobial activity (Klimek et al., 2009). Mullein (*Verbascum phlomoides*) used in folk medicine due to its anti-inflammatory and soothing action on the respiratory tract is thoroughly documented in the scientific literature. Polyphenols in *Verbascum phlomoides* have an essential role in exerting the antioxidant effect. Still, they have a weak influence on anti-inflammatory activity correlated, probably, to a higher content of iridoids and phenylethanoids (Grigore et al., 2013). *Verbascum thapsus* is used in traditional medicine as an antispasmodic and anti-tubercular agent (Ali et al., 2012).
Mullein flowers (*Verbasci flos*) are reported to have expectorant properties in Serbia and other Balkan countries. They have been used in traditional medicine to treat respiratory conditions such as common cold and dry cough (Šarić Kundalić et al., 2010), antitussive (Mustafa et al., 2015), aids the coughing up the mucus (Jarić et al., 2015a), bronchitis (Mustafa et al., 2015; Tsioutsiou et al., 2019), expectorant, cough, tuberculosis, and asthma (Tsioutsiou et al., 2019). The ethnomedicinal uses of *Verbascum phlomoides* include the following applications: expectorant, laryngitis, asthma (Jarić et al., 2007), bronchitis (Jarić et al., 2007; Menković et al., 2011; Rexhepi et al., 2013), influenza, tuberculosis (Jarić et al., 2007; Rexhepi et al., 2013), catarrh of the respiratory tract, cough (Menković et al., 2011), cold and fever (Rexhepi et al., 2013). The ethnomedicinal uses of *Verbascum densiflorum* and *Verbascum thapsus* include catarrh of the respiratory tract, cough, and bronchitis (Menković et al., 2011). The use of *Verbascum longifolium* has a cough (Tsioutsiou et al., 2019).

Inula helenium

Elecampane (*Inula helenium*), also called horse-heal or elf dock, has also been used in traditional medicine to treat respiratory system diseases. The studies of (Gierlikowska et al., 2020) justify the conventional use of *I. helenium* roots to treat infections in the respiratory tract associated with bronchial inflammation. Stojanović-Radić et al. (2011) were investigated hydro-distilled essential oil of *Inula helenium* roots. In this study, sesquiterpene lactones were the most active oil principles responsible for the exhibited antimicrobial activity.
The ethnomedicinal uses of elecampane (*Inula helenium*) in the treatment of respiratory system diseases among the Serbian population were: expectorant, antitussive, bronchitis, hay fever, asthma (Jarić et al., 2007) cough (Živković et al., 2020; Jarić et al., 2007; Pieroni et al., 2011; Šavikin et al., 2013), tuberculosis (Jarić et al., 2007; Matejić et al., 2020), colds (Janaćković et al., 2019).

Pinus sylvestris and other Pinus species

Scots Pine (*Pinus sylvestris*) has been used in traditional medicine to treat respiratory system diseases. The ethnomedical heritage about use of *Pinus sylvestris* among the Serbian population against respiratory infections includes the following applications: chronically bronchitis (Jarić et al., 2007), colds (Janaćković et al., 2019; Jarić et al., 2015b), cough, pneumonia (Janaćković et al., 2019), productive cough and asthma (Matejić et al., 2020) and respiratory disorders in general (Živković et al., 2020).

The other *Pinus* species have also had medicinal use in treating respiratory system disorders, mainly in the mountain areas. European black pine (*Pinus nigra*), in ethnobotanical studies of Serbia and the Balkan Peninsula, was mentioned in the treatment of pulmonary ailments (Šarić Kundalić et al., 2010) and against inflammation of the respiratory organs (Janaćković et al., 2019). The genetic distance of the European black pine identified three differentiated genetic groups, which corresponded to three vast geographical areas: Westerns Mediterranean, Balkan Peninsula, and Asia (Naydenov et al., 2016). In the antimicrobial assays, the tested oils of three taxa of *Pinus nigra* from Serbia (ssp. *nigra*, ssp. *pallasiana*, and var. *banatica*) have been registered inhibitory effects ranged from 20.00 to 0.62 mg/mL (Šarac et al., 2014), where var. *banatica* exhibited the highest and ssp. *nigra* the lowest antimicrobial action (Šarac et al., 2014). According to the same authors, active compounds responsible for the mode of action were the most abundant terpenoid (germacrene D-4-ol) and its structurally similar terpene (germacrene D), both present in all three essential oils. Sesquiterpene lactones, belonging to the plant terpenoid group, can also play an indispensable role as antibacterials and anti-virals (Matejić et al., 2020).

Pinus mugo (dwarf mountain pine), a species native to central and southern Europe has also been used in traditional medicine in the Balkans in the treatment of pulmonary ailments (Šarić Kundalić et al., 2010), inhalation in common colds, cough, and bronchitis (Menković et al., 2011). *Pinus heldreichii* (Bosnian pine) has been used in traditional medicine in the middle, south, and west Bosnia and Herzegovina to treat pulmonary ailments (Šarić Kundalić et al., 2010). *Pinus heldreichii* mainly form pure stands but can appear in mixed populations, most commonly with *Pinus peuce* – Macedonian pine (Rajčević et al., 2019). The essential oils of *P. heldreichii* showed inhibitory action against respiratory pathogenic bacterial strains isolated from human swabs (Mitić et al., 2019). These results suggested that diterpene alcohol thunbergol might be an essential antimicrobial agent either alone or in combination with other compounds.

Origanum vulgare

The ethnomedicinal uses of *Origanum vulgare*, among other Balkan territories, against respiratory infections, include the following applications: respiratory disorders (Menković et al., 2011), respiratory problems, especially cough and bronchitis (Rexhepi et al., 2013), sore throat, cough, fever, headache (Pieroni et al., 2014a), influenza (Mustafa et al., 2015; Pieroni et al., 2014b;a), antitussive and respiratory system infections (Mustafa et al., 2015). The main component in essential oil from *Origanum vulgare* ssp. *hirtum*, as well as in hydrolats, was carvacrol (Drinić et al., 2020). According to the same authors, residual extracts after conventional hydro-distillation and microwave-assisted hydro-distillation proved to be rich in phenols (rosmarinic acid as dominant), representing valuable by-products.

4.2. Medium and scarcely used plants in the treatment of respiratory infections

Petasites hybridus

Common butterbur (*Petasites hybridus*) is used in the traditional medicine of Prokletije Mts. to treat respiratory diseases in general and asthma (Menković et al., 2011). It contains many active compounds of potential therapeutic activity and toxic pyrrolizidine alkaloids (Mihajilov-Krstev et al., 2020). The application of an extract of *P. hybridus* can become an effective anti leukotriene herbal product in leukotriene-mediated inflammatory diseases, such as asthma and chronic obstructive pulmonary disease (Ożarowski et al., 2013).

Ribes nigrum and Ribes rubrum

Dogan et al. (2020) were noted that crude plant extracts could be an essential resource for the development of new anti respiratory virus agents. The same authors were determined that leaf methanol and aqueous fruit extracts of *Ribes uva crispa* had intense activity against respiratory viruses. In ethnobotanical studies of the Balkan Peninsula, it was noted that the black currant (*Ribes nigrum*) was used in the treatment of cold (Šavikin et al., 2013) and cough (Šarić Kundalić et al., 2016). Black currant (*Ribes nigrum*) and red currant (*Ribes rubrum*) were used in mixtures in the treatment of cough and asthma (Šarić Kundalić et al., 2010). Black currant extracts had inhibitory effects on pathogens associated with oral, respiratory, and nasopharyngeal infections (Ikuta et al., 2012). Quantitative analyses of anthocyanin aglycones in berries were performed by Đorđević et al. (2014). According to the same authors, total phenolics and anthocyanins contents decreased during berry fruits' processing to juices. The buds' essential oil composition similarity, harvested from the upper and lower parts of the shrubs of black currant, was investigated. It was demonstrated that the essential oils had robust inhibitory activity against tested microorganisms (Đorđević et al., 2014). Bilberry (*Vaccinium myrtillus*) was used in ethnomedicine on Balkans in the treatment of inflammation of mouth and throat (Menković et al., 2011), against viral infections, as a gargle for throat wash (Rexhepi et al., 2013) and against respiratory inflammations (Mustafa et al., 2015). A detailed phenolic composition analysis of bilberry and black currant fruit teas prepared in the most common ways — decoction and infusion, was performed (Šavikin et al., 2014).

Saponaria officinalis

According to Sharma et al. (2011) anti-viral herbal drug, with the common name bouncing bet, which biological source is leaf, root, and bark of *Saponaria officinalis*, have the following mode of action: reproduction inhibition of various strains of influenza virus types A and B, and herpes simplex virus type. We assume that saponins and some of the ingredients of essential oil have a pharmacological effect on viruses. Phytochemical analysis of the essential oil samples obtained from fresh shoots and flowers of *Saponaria officinalis* allowed the identification of 96 different ingredients in total (Petrović et al., 2017). In further pharmacological studies, it is worth examining the effect of found components of essential oil on respiratory viruses.

Hyssopus officinalis

Hyssopus officinalis is traditionally used for its antiseptic properties in the treatment of infectious diseases. It is known to have antimicrobial and anti-viral effects. Its above-ground parts are used as an antiseptic and treat chronic bronchitis and asthma (Stanković et al., 2016a;b). In ethnobotanical studies in Serbia, *Hyssopus officinalis* was mentioned in the treatment of cough (Zlatković et al., 2014), pulmonary problems and

asthma (Jarić et al., 2015a), and bronchitis (Živković et al., 2020; Jarić et al., 2015a).

Artemisia absinthium

Artemisia absinthium in ethnobotanical studies in Serbia and Balkan Peninsula was mentioned in the treatment of asthma (Matejić et al., 2020; Menković et al., 2011; Mustafa et al., 2015), cold (externally) (Jarić et al., 2015a), and productive cough (Matejić et al., 2020). *Artemisia absinthium* essential oil chemical composition and biological activities were studied (Mihajilov-Krstev et al., 2014a). Gram-negative bacterium *Klebsiela pneumonia* can cause destructive changes to human lungs. The activity of methanol extracts of *Artemisia absinthium* against *Klebsiela pneumonia* strains was more substantial than the referent antibiotics (Stanković et al., 2016b).

Satureja montana

Satureja montana in ethnobotanical studies in Serbia and Balkan Peninsula was mentioned in the treatment of respiratory problems, colds, asthma (Jarić et al., 2015a), respiratory tract infections, antitussive and expectorant (Mustafa et al., 2015), cough (Jarić et al., 2015a; Tsioutsiou et al., 2019), bronchitis (Jarić et al., 2015a; Matejić et al., 2020), inflammation of the respiratory tract (Tsioutsiou et al., 2019), and productive cough (Matejić et al., 2020). High antimicrobial potential, together with moderate antioxidant capacity, classified *Satureja montana* essential oil as a natural source of compounds that can be used in the treatment of infectious diseases and general health improvement (Mihajilov-Krstev et al., 2014b).

Teucrium polium

Teucrium polium in ethnobotanical studies in Balkan Peninsula was mentioned in treating tuberculosis (Mustafa et al., 2015). The aerial parts essential oils' chemical composition of *Teucrium polium* collected during the flowering period from rocky places, and dry pastures in Serbia and dunes along the sea-side in Bulgaria has been studied. The identified compounds, 45 for the oil from Serbia and 44 for Bulgaria, amounted to 97.3 % and 96.4 % of the oils, respectively. The Serbian oil's dominant constituents were sesquiterpenes, while a high percentage of monoterpenes characterized the essential oil from Bulgaria.

Hypericum spp.

Species from the genus *Hypericum* were mentioned in ethnobotanical studies of Serbia and the Balkan Peninsula. *Hypericum montanum* and *Hypericum perforatum* were mentioned as expectorants against pulmonary ailments, bronchitis, and asthma (Pieroni et al., 2005; 2011). *Hypericum montanum* was mentioned in the treatment of cough (Pieroni et al., 2011). *Hypericum perforatum* was also discussed in the treatment of sore throat (Pieroni et al., 2014a), pulmonary ailments, and throat inflammations (Šarić Kundalić et al., 2016). *Hypericum maculatum* is traditionally used against influenza, sore throat coughs, bronchitis (Pieroni et al., 2005) and *Hypericum tetrapterum* against pulmonary ailments, bronchitis, and asthma (Šarić Kundalić et al., 2010). The crude methanol extracts of *Hypericum* species from the Balkan Peninsula were tested for *in vitro* antimicrobial and antioxidant activities. All extracts possessed a comprehensive spectrum of strong antimicrobial activity (Radulović et al., 2007).

Mentha × *piperita*

Extracts and essential oils of *Mentha* × *piperita* exert effects against a broad spectrum of bacteria, closely related to its well-known phytochemical composition, which suggests and even prompts their safe use (Salehi et al., 2018). In ethnobotanical studies in Serbia, mint (*Mentha* × *piperita*) was mentioned in the treatment of influenza (Jarić et al., 2007), fever (Šavikin et al., 2013), cold (Jarić et al., 2015a; Šavikin et al., 2013), bronchitis (Matejić et al., 2020). In ethnobotanical studies in other Balkan countries, the mint was mentioned in the treatment of asthma (Šarić Kundalić et al., 2010), cough (Šarić Kundalić et al., 2010), (Rexhepi et al., 2013), respiratory problems in general (Rexhepi et al., 2013), and throat inflammations (Šarić Kundalić et al., 2016).

Lavandula officinalis

Lavandula officinalis was mentioned in the treatment of pulmonary ailments in ethnobotanical studies on Suva Planina Mts. (Jarić et al., 2015a) where there are huge fields planted with lavender. The microdilution broth susceptibility assay revealed that lavender essential oils were more efficient in inhibiting bacterial growth than other tested oils, with a minimum inhibitory concentration of 5 μg/mL (Kokina et al., 2019).

Gentiana lutea

Gentiana lutea was mentioned in the treatment of cough and cold in Serbia's ethnobotanical studies (Pieroni et al., 2014a) and the treatment of respiratory system problems – influenza and cold in ethnobotanical studies of other Balkan countries (Rexhepi et al., 2013). Iridoids, xanthones, and flavonoids are biologically active compounds in *Gentiana* species (Menković et al., 2016).

Glechoma hederaceae and Glechoma hirsuta

Glechoma species are traditionally used in the treatment of respiratory system diseases. In Serbia's ethnobotanical studies, it was mentioned that *Glechoma hederacea* has a tonic effect on the bronchial system (Jarić et al., 2007) while in other Balkan countries on respiratory system disorders in general (Šarić Kundalić et al., 2016). *Glechoma hederacea*e and *Glechoma hirsuta* were mentioned to treat tuberculosis, bronchitis, cough, and influenza (Šarić Kundalić et al., 2010).

Dactylorhiza latifolia and Orchis morio

Tubers of *Dactylorhiza latifolia* and *Orchis morio*, as well as other species from family Orchidaceae, are collected from the wild and used to prepare a beverage, called "salep," used as a cough remedy popular in several Balkan countries (Živković et al., 2020; Pieroni et al., 2014b; Šarić Kundalić et al., 2016). Similar uses were reported for *Orchis morio* in South Kosovo and Metohija, where the tuber infusion is indicated as a remedy for influenza (Mustafa et al., 2015).

5. CONCLUDING REMARKS

This review identified 213 plant taxa from 57 families represented in the folk medicine at 18 localities dispersed across the Balkan Peninsula. The most commonly used plant taxa, mentioned in ethnobotanical surveys, we comprised in this review, were *Matricaria chamomilla* and *Tussilago farfara* (recorded at 12 localities each), *Plantago major*, *Rosa canina*, and *Sambucus nigra* (11 localities each), *Althaea officinalis*, and *Thymus* spp. (10 localities), *Primula veris* and *Salvia officinalis* (9 localities each), *Achillea millefolium*, *Ocimum basilicum*, *Tilia cordata*, and *Verbascum* sp. (8 localities each). The most abundantly reported families were Lamiaceae (44 species), Rosaceae (22 species), and Asteraceae (18 species).

Surveys conducted on the territory of Serbia revealed 119 species used in traditional medicine for various respiratory disorders. These data indicate that the most commonly used plant species in all investigated localities were *Sambucus nigra* (8 localities), *Achillea millefolium*, *Althaea officinalis*, *Matricaria chamomilla*, and *Thymus* sp. (7 localities each), *Inula helenium*, *Primula veris*, and *Tussilago farfara* (6 localities each), *Ocimum basilicum*, *Plantago major*, *Pinus sylvestris*, *Rosa canina*, *Salvia*

officinalis, and *Tilia cordata* (5 localities each). Moreover, all recorded plants from these surveys are classified into 41 families, of which the most abundant were Lamiaceae (26 species), Rosaceae (13 species), and Asteraceae (12 species).

For the same indications, the population of other examined Balkan territories reported 171 plant species distributed in 48 families. In the localities covered by this review, the most frequent plant species were *Rosa canina*, *Sambucus nigra*, *Tussilago farfara* (mentioned at 6 localities each), *Matricaria chamomilla*, and *Origanum vulgare* (5 localities each). Reported plants from these localities were also grouped into the most abundant families, such as Lamiaceae (33 species), Rosaceae (18 species), and Asteraceae (13 species).

The common medications in treating respiratory system disorders are associated with several unwanted side effects, especially throughout long-term treatment. Herbal medicines are an alternative treatment for respiratory infections. The importance of medicinal plants has increased over time. They have long been used to treat and prevent viral respiratory infections. The herbal remedies in the presented study can shorten symptoms of colds and flu and other infections.

With the emergence of COVID 19 and newer, more virulent strains of viruses and bacteria, the search for effective drugs to treat respiratory diseases will continue. Traditional herbal remedies offer a broad spectrum of anti-viral health benefits. Herbal remedies are safer, more effective, and less expensive than synthetic drugs.

Herbal medicines included in this review describe how nature has provided safe, effective prevention methods against viruses and bacteria responsible for respiratory infections. They can improve the health and quality of life of the human population. Further studies are required to evaluate the efficacy of mentioned plants in patients suffering from respiratory diseases and the mechanisms through which these plants can help millions of people affected by the respiratory system's infections.

ACKNOWLEDGMENTS

Present study is part of the project: "Ethno-pharmacological study of the region of Southeastern Serbia", O-02-17, supported by the Serbian Academy of Sciences and Arts.

REFERENCES

Adamczak, A., Opala, B., Gryszczyńska, A. and Buchwald, W. (2013). Content of pyrrolizidine alkaloids in the leaves of coltsfoot (*Tussilago farfara* L.) in Poland, *Acta Societatis Botanicorum Poloniae* **82**(4): 289–293.

Akram, M. (2013). Minireview on *Achillea millefolium* Linn., *The Journal of Membrane Biology* **246**(9): 661–663.

Al Abbasy, D. W., Pathare, N., Al-Sabahi, J. N. and Khan, S. A. (2015). Chemical composition and antibacterial activity of essential oil isolated from omani basil (*Ocimum basilicum* Linn.), *Asian Pacific Journal of Tropical Disease* **5**(8): 645–649.

Ali, N., Ali Shah, S. W., Shah, I., Ahmed, G., Ghias, M., Khan, I. and Ali, W. (2012). Anthelmintic and relaxant activities of *Verbascum thapsus* mullein, *BMC Complementary and Alternative Medicine* **12**(1).

Barrett, B. (2018). Viral upper respiratory infection, *Integrative Medicine*, Elsevier, pp. 170–179.e7.

Basch, E., Ulbricht, C., Hammerness, P. and Vora, M. (2003). Marshmallow (*Althaea officinalis* L.) monograph, *Journal of Herbal Pharmacotherapy* **3**: 71–81.

Dajić Stevanović, Z., Petrović, M. and Aćić, S. (2014). Ethnobotanical knowledge and traditional use of plants in serbia in relation to sustainable rural development, *Ethnobotany and Biocultural Diversities in the Balkans*, Springer New York, pp. 229–252.

Džamić, A. M. and Matejić, J. S. (2017). Aromatic plants from Western Balkans: A potential source of bioactive natural compounds, *Active Ingredients from Aromatic and Medicinal Plants*, InTech.

Đorđević, B. S., Pljevljakušić, D. S., Šavikin, K. P., Stević, T. R. and Bigović, D. J. (2014). Essential oil from blackcurrant buds as chemotaxonomy marker and antimicrobial agent, *Chemistry & Biodiversity* **11**(8): 1228–1240.

Dogan, H., Duman, R. and Dinc, M. (2020). Antiviral activity of *Ribes uva-crispa* L. extracts *in vitro*., *Pakistan Journal of Pharmaceutical Sciences* **33**(3): 1173–1178.

Dragicević, S., Kovačević, D., Divac-Rankov, A., Nikolić, A., Radojković, D. and Radović, S. (2019). Evaluation of toxicity and antioxidative effects of *Tussilago farfara* and *Verbascum thapsus* water extracts in zebrafish and in bronchial epithelial cells, *Archives of Biological Sciences* **71**(3): 409–416.

Drinić, Z., Pljevljakušić, D., Živković, J., Bigović, D. and Šavikin, K. (2020). Microwave-assisted extraction of *O. vulgare* L. spp. *hirtum* essential oil: Comparison with conventional hydro-distillation, *Food and Bioproducts Processing* **120**: 158–165.

EMA (2015). European union herbal monograph on *Matricaria recutita* L., flos, European Medicines Agency, Science Medicine Health, Committee on Herbal Medicinal Products, EMA/HMPC/55843/2011.

Ghorbani, A. and Esmaeilizadeh, M. (2017). Pharmacological properties of *Salvia officinalis* and its components, *Journal of Traditional and Complementary Medicine* **7**(4): 433–440.

Gierlikowska, B., Gierlikowski, W., Bekier, K., Skalicka-Woźniak, K., Czerwińska, M. E. and Kiss, A. K. (2020). *Inula helenium* and *Grindelia squarrosa* as a source of compounds with anti-inflammatory activity in human neutrophils and cultured human respiratory epithelium, *Journal of Ethnopharmacology* **249**: 112311.

Grigore, A., Colceru-Mihul, S., Litescu, S., Panteli, M. and Rasit, I. (2013). Correlation between polyphenol content and anti-inflammatory activity of *Verbascum phlomoides* (mullein), *Pharmaceutical Biology* **51**(7): 925–929.

Halicioglu, O., Astarcioglu, G., Yaprak, I. and Aydinlioglu, H. (2011). Toxicity of *Salvia officinalis* in a newborn and a child: An alarming report, *Pediatric Neurology* **45**(4): 259–260.

Hamidi, S., Vaez, H. and Asgharian, P. (2015). *Rosa canina* as an adjunctive treatment of asthma: A hypothesis„ *Advances in Bioscience and Clinical Medicine* **3**: 48–52.

Harnett, J., Oakes, K., Carè, J., Leach, M., Brown, D., Cramer, H., Pinder, T.-A., Steel, A. and Anheyer, D. (2020). The effects of *Sambucus nigra* berry on acute respiratory viral infections: A rapid review of clinical studies, *Advances in Integrative Medicine* **7**(4): 240–246.

Hawkins, J., Baker, C., Cherry, L. and Dunne, E. (2019). Black elderberry (*Sambucus nigra*) supplementation effectively treats upper respiratory symptoms: A meta-analysis of randomized, controlled clinical trials, *Complementary Therapies in Medicine* **42**: 361–365.

Ikuta, K., Hashimoto, K., Kaneko, H., Mori, S., Ohashi, K. and Suzutani, T. (2012). Anti-viral and anti-bacterial activities of an extract of blackcurrants (*Ribes nigrum* L.), *Microbiology and Immunology* **56**(12): 805–809.

Ilić, B. S., Miladinović, D. L., Kocić, B. D., Spalović, B. R., Marković, M. S., Čolović, H. and Nikolić, D. M. (2017). Chemoinformatic investigation of antibiotic antagonism: The interference of *Thymus glabrescens* essential oil components with the action of streptomycin, *Natural Product Communications* **12**(10): 1934578X1701201.

Ismail, A.and Hneini, F. and Nawas, T. . (2019). Tilia cordata: a potent inhibitor of growth and biofilm formation of bacterial clinical isolates, *World Journal of Pharmaceutical Research* **8**: 147–158.

Živković, J., Ilić, M., Šavikin, K., Zdunić, G., Ilić, A. and Stojković, D. (2020). Traditional use of medicinal plants in South-Eastern Serbia (Pčinja District): Ethnopharmacological investigation on the current status and comparison with half a century old data, *Frontiers in Pharmacology* **11**.

Janaćković, P., Gavrilović, M., Savić, J., Marin, P. and Dajić Stevanović, Z. (2019). Traditional knowledge of plant use from Negotin Krajina (Eastern Serbia): An ethnobotanical study, *Indian Journal of Traditional Knowledge* **18**: 25–33.

Janković, T., Zdunić, G., Beara, I., Balog, K., Pljevljakušić, D., Stešević, D. and Šavikin, K. (2012). Comparative study of some polyphenols in *Plantago* species, *Biochemical Systematics and Ecology* **42**: 69–74.

Jarić, S., Mačukanović-Jocić, M., Djurdjević, L., Mitrović, M., Kostić, O., Karadžić, B. and Pavlović, P. (2015b). An ethnobotanical survey of traditionally used plants on Suva planina mountain (south-eastern Serbia), *Journal of Ethnopharmacology* **175**: 93–108.

Jarić, S., Mitrović, M., Karadžić, B., Kostić, O., Djurjević, L., Pavlović, M. and Pavlović, P. (2014). Plant resources used in Serbian medieval

medicine. Ethnobotany and ethnomedicine, *Genetic Resources and Crop Evolution* **61**(7): 1359–1379.

Jarić, S., Mitrović, M. and Pavlović, P. (2015a). Review of ethnobotanical, phytochemical, and pharmacological study of *Thymus serpyllum* L., *Evidence-Based Complementary and Alternative Medicine* **2015**: 1–10.

Jarić, S., Popović, Z., Mačukanović-Jocić, M., Djurdjević, L., Mijatović, M., Karadžić, B., Mitrović, M. and Pavlović, P. (2007). An ethnobotanical study on the usage of wild medicinal herbs from Kopaonik mountain (Central Serbia), *Journal of Ethnopharmacology* **111**(1): 160–175.

Jovanović, A. A., Đorđević, V. B., Zdunić, G. M., Pljevljakušić, D. S., Šavikin, K. P., Gođevac, D. M. and Bugarski, B. M. (2017). Optimization of the extraction process of polyphenols from *Thymus serpyllum* L. herb using maceration, heat- and ultrasound-assisted techniques, *Separation and Purification Technology* **179**: 369–380.

Jovanović, A., Đordjević, V., Zdunić, G., Šavikin, K., Pljevljakusic, D. and Bugarski, B. (2016). Ultrasound-assisted extraction of polyphenols from *Thymus serpyllum* and its antioxidant activity, *Chemical Industry* **70**(4): 391–398.

Jug-Dujaković, M., Ristić, M., Pljevljakušić, D., Dajić-Stevanović, Z., Liber, Z., Hančević, K., Radić, T. and Šatović, Z. (2012). High diversity of indigenous populations of dalmatian sage (*Salvia officinalis* L.) in essential oil composition, *Chemistry and Biodiversity* **9**(10): 2309–2323.

Khan, A.-u. and Gilani, A. H. (2010). Blood pressure lowering, cardiovascular inhibitory and bronchodilatory actions of *Achillea millefolium*, *Phytotherapy Research* **25**(4): 577–583.

Klimek, B., Olszewska, M. A. and Tokar, M. (2009). Simultaneous determination of flavonoids and phenylethanoids in the flowers of *Verbascum densiflorum* and *V. phlomoides* by high-performance liquid chromatography, *Phytochemical Analysis* **21**(2): 150–156.

Kokina, M., Kalušević, A., Nedović, V., Nikšić, M., Shamtsyan, M., Šavikin, K., Pljevljakušić, D., Pantić, M., Lević, S. and Salević, A. (2019). Characterization, antioxidant and antibacterial activity of essential oils and their encapsulation into biodegradable material followed by freeze drying, *Food technology and biotechnology* **57**(2): 282–289.

Lupitu, A., Tomescu, D., Mot, C., Moisa, C.and Copolovici, D. and Copolovici, L. (2018). Variation in phenolic content and antioxidant activity of different plant parts of *Primula veris*, *Scientific Bulletin. Series F. Biotechnologies* **22**: 50–53.

Mahboubi, M. (2019). Marsh mallow (*Althaea officinalis* L.) and its potency in the treatment of cough, *Complementary Medicine Research* **27**(3): 174–183.

Marković, M. (2019). Application of yarrow (*Achillea millefolium* L.) in ethnomedicine of the Pirot county (southeastern Serbia), *Arhiv za farmaciju* **69**(5): 367–384.

Marković, M., Matović, M. and Rakonjac, L. (2019). Review of aromatic plants of the Vidlič mountain by phytocenological affiliation, *Pirotski zbornik* **44**: 65–85.

Marković, M., Pljevljakušić, D., Kojičić, K. and Cupara, S. (2020a). Ethnopharmacological application of chamomile (*Matricaria chamomilla* L.) in the Pirot County of Southeastern Serbia, *Arhiv za farmaciju* **70**(4): 238–247.

Marković, M., Pljevljakušić, D., Nikolić, B. and Rakonjac, L. (2020b). Application of dog rose (*Rosa canina* L.) in ethnomedicine of the Pirot County, *Pirotski zbornik* **45**: 1–16.

Marković, M., Pljevljakušić, D., Nikolić, B., Rakonjac, L. and Stankov-Jovanović, V. (2020c). Ethnomedicinal application of species from genus *Thymus* in the Pirot County (Southeastern Serbia), *Lekovite sirovine* **40**: 27–32.

Matejić, J. S., Stefanović, N., Ivković, M., Živanović, N., Marin, P. D. and Džamić, A. M. (2020). Traditional uses of autochthonous medicinal and ritual plants and other remedies for health in Eastern and South-Eastern Serbia, *Journal of Ethnopharmacology* **261**: 113186.

Matev, M., Angelova, I., Koĭchev, A., Leseva, M. and Stefanov, G. (1982). Clinical trial of a *Plantago major* preparation in the treatment of chronic bronchitis„ *Vutreshni Bolesti* **21**: 133–137.

Menković, N., Šavikin, K., Tasić, S., Zdunić, G., Stešević, D., Milosavljević, S. and Vincek, D. (2011). Ethnobotanical study on traditional uses of wild medicinal plants in Prokletije Mountains (Montenegro), *Journal of Ethnopharmacology* **133**(1): 97–107.

Menković, N., Živković, J., Šavikin, K., Janković, T., Zdunić, G. and Pljevljakušić, D. (2016). Optimization of ultrasound-assisted extraction of isogentisin from *Gentiana lutea* L. roots by response surface methodology, *Planta Medica* **81**(S 01): S1–S381.

Mihajilov-Krstev, T., Jovanović, B., Jović, J., Ilić, B., Miladinović, D., Matejić, J., Rajković, J., Đorđević, L., Cvetković, V. and Zlatković, B. (2014a). Antimicrobial, antioxidative, and insect repellent effects of *Artemisia absinthium* essential oil, *Planta Medica* **80**(18): 1698–1705.

Mihajilov-Krstev, T., Jovanović, B., Zlatković, B., Matejić, J., Vitorović, J., Cvetković, V., Ilić, B., Đorđević, L., Joković, N., Miladinović, D., Jakšić, T., Stanković, N., Stankov Jovanović, V. and Bernstein, N. (2020). Phytochemistry, toxicology and therapeutic value of *Petasites hybridus* subsp. *Ochroleucus* (common butterbur) from the Balkans, *Plants* **9**(6): 700.

Mihajilov-Krstev, T., Radnović, D., Kitić, D., Jovanović, V., Mitić, V., Stojanović-Radić, Z. and Zlatković, B. (2014b). Chemical composition, antimicrobial, antioxidative and anticholinesterase activity of *Satureja Montana* L. ssp *montana* essential oil, *Open Life Sciences* **9**(7): 668–677.

Miladinović, D. L., Dimitrijević, M. V., Mihajilov-Krstev, T. M., Marković, M. S. and Ćirić, V. M. (2021). The significance of minor components on the antibacterial activity of essential oil via chemometrics, *LWT* **136**: 110305.

Mitić, V., Jovanović, O., Stankov-Jovanović, V., Zlatkovic, B. and Stojanovic, G. (2012). Analysis of the essential oil of *Teucrium polium* ssp. *capitatum* from the Balkan Peninsula, *Natural Product Communications* **7**(1): 1934578X1200700.

Mitić, Z. S., Jovanović, B., Jovanović, S. ., Stojanović-Radić, Z. Z., Mihajilov-Krstev, T., Jovanović, N. M., Nikolić, B. M., Marin, P. D., Zlatković, B. K. and Stojanović, G. S. (2019). Essential oils of *Pinus halepensis* and *P. heldreichii*: Chemical composition, antimicrobial and insect larvicidal activity, *Industrial Crops and Products* **140**: 111702.

Mustafa, B., Hajdari, A., Pieroni, A., Pulaj, B., Koro, X. and Quave, C. L. (2015). A cross-cultural comparison of folk plant uses among Albanians, Bosnians, Gorani and Turks living in south Kosovo, *Journal of Ethnobiology and Ethnomedicine* **11**(1): 1–26.

Naydenov, K. D., Naydenov, M. K., Alexandrov, A., Vasilevski, K., Gyuleva, V., Matevski, V., Nikolić, B., Goudiaby, V., Bogunić, F., Paitaridou, D., Christou, A., Goia, I., Carcaillet, C., Alcantara, A. E., Ture, C., Gulcu, S., Peruzzi, L., Kamary, S., Bojović, S., Hinkov, G. and Tsarev, A. (2016). Ancient split of major genetic lineages of european black pine: evidence from chloroplast DNA, *Tree Genetics & Genomes* **12**(4): 68.

Nikolić, B., Matović, M., Mladenović, K., Todosijević, M., Stanković, J., Đorđević, I., Marin, P. D. and Tešević, V. (2019). Volatiles of *Thymus serpyllum* obtained by three different methods, *Natural Product Communications* **14**(6): 1934578X1985625.

Ożarowski, M., Przystanowicz, J. and Adamczak, A. (2013). Phytochemical, pharmacological and clinical studies of *Petasites hybridus* (L.) P. Gaertn., B. Mey. & Scherb.: A review, *Herba Polonica* **59**(4): 108–128.

Petrović, G. M., Ilić, M. D., Stankov-Jovanović, V. P., Stojanović, G. S. and Jovanović, S. . (2017). Phytochemical analysis of *Saponaria officinalis* L. shoots and flowers essential oils, *Natural Product Research* **32**(3): 331–334.

Pieroni, A., Dibra, B., Grishaj, G., Grishaj, I. and Gjon Maçai, S. (2005). Traditional phytotherapy of the Albanians of Lepushe, Northern Albanian Alps, *Fitoterapia* **76**(3-4): 379–399.

Pieroni, A., Giusti, M. E. and Quave, C. L. (2011). Cross-cultural ethnobiology in the Western Balkans: Medical ethnobotany and ethnozoology among Albanians and Serbs in the Pešter Plateau, Sandžak, South-Western Serbia, *Human Ecology* **39**(3): 333–349.

Pieroni, A., Ibraliu, A., Abbasi, A. M. and Papajani-Toska, V. (2014b). An ethnobotanical study among Albanians and Aromanians living in the Rraicë and Mokra areas of Eastern Albania, *Genetic Resources and Crop Evolution* **62**(4): 477–500.

Pieroni, A., Nedelcheva, A., Hajdari, A., Mustafa, B., Scaltriti, B., Cianfaglione, K. and Quave, C. L. (2014a). Local knowledge on plants and domestic remedies in the mountain villages of Peshkopia (Eastern Albania), *Journal of Mountain Science* **11**(1): 180–193.

Pljevljakušić, D., Šavikin, K., Janković, T., Zdunić, G., Ristić, M., Godjevac, D. and Konić-Ristić, A. (2011). Chemical properties of the cultivated *Sideritis raeseri* Boiss. /& Heldr. subsp. *raeseri*, *Food Chemistry* **124**(1): 226–233.

Pljevljakušić, D., Ristić, M. and Šavikin, K. (2017). Screening of yarrow (*Achillea millefolium* Agg.) populations in Serbia for yield components and essential oil composition, *Lekovite sirovine* **37**: 25–32.

Radulović, N., Stankov-Jovanović, V., Stojanović, G., Šmelcerović, A., Spiteller, M. and Asakawa, Y. (2007). Screening of *in vitro* antimicrobial and antioxidant activity of nine *Hypericum* species from the Balkans, *Food Chemistry* **103**(1): 15–21.

Rajčević, N., Nikolić, B. and Marin, D. (2019). Different responses to environmental factors in terpene composition of *Pinus heldreichii* and P. peuce: Ecological and chemotaxonomic considerations, *Archives of Biological Sciences* **71**(4): 629–637.

Rexhepi, B., Mustafa, B., Hajdari, A., Rushidi-Rexhepi, J., Quave, C. L. and Pieroni, A. (2013). Traditional medicinal plant knowledge among Albanians, Macedonians and Gorani in the Sharr Mountains (Republic of Macedonia), *Genetic Resources and Crop Evolution* **60**(7): 2055–2080.

Salehi, B., Stojanović-Radić, Z., Matejić, J., Sharopov, F., Antolak, H., Kręgiel, D., Sen, S., Sharifi-Rad, M., Acharya, K., Sharifi-Rad, R., Martorell, M., Sureda, A., Martins, N. and Sharifi-Rad, J. (2018). Plants of genus *Mentha*: From farm to food factory, *Plants* **7**(3): 70.

Samuelsen, A. B. (2000). The traditional uses, chemical constituents and biological activities of *Plantago major* L. A review, *Journal of Ethnopharmacology* **71**(1-2): 1–21.

Schulz, V., Hänsel, R. and Tyler, V. E. (2001). *Rational Phytotherapy*, Springer Berlin Heidelberg.

Sharma, S., Khatri, P. and Munna, N. (2011). Potent herbal anti-viral drugs – A review, *IJPI's Journal of Pharmacognosy and Herbal Formulations* **1(4):**(4): 85–92.

Siddiqui, B. S., Bhatti, H. A., Begum, S. and Perwaiz, S. (2012). Evaluation of the antimycobacterium activity of the constituents from *Ocimum basilicum* against *Mycobacterium tuberculosis*, *Journal of Ethnopharmacology* **144**(1): 220–222.

Stanković, N., Mihajilov-Krstev, T., Zlatković, B., Matejić, J., Stankov Jovanović, V., Kocić, B. and Čomić, L. (2016a). Comparative study of composition, antioxidant, and antimicrobial activities of essential oils of selected aromatic plants from Balkan Peninsula, *Planta Medica* **82**(7): 650–661.

Stanković, N., Mihajilov-Krstev, T., Zlatković, B., Stankov-Jovanović, V., Mitić, V., Jović, J., Čomić, L., Kocić, B. and Bernstein, N. (2016b). Antibacterial and antioxidant activity of traditional medicinal plants from the Balkan Peninsula, *NJAS: Wageningen Journal of Life Sciences* **78**(1): 21–28.

Stevanović, V. (1999). *The Red Data Book of Flora of Serbia, extinct and critically endangered taxa*, Vol. 1, Ministry of Environment of the Republic of Serbia, Faculty of Biology, University of Belgrade, Institution for Protection of Nature of the Republic of Serbia, Belgrade.

Stojanović, G., Jovanović, O., Petrović, G., Mitić, V., Jovanović, V. S. and Jovanović, S. (2014). Composition of headspace volatiles and essential oils of three *Thymus* species, *Natural Product Communications* **9**(11): 1934578X1400901.

Stojanović-Radić, Z., Čomić, L., Radulović, N., Blagojević, P., Denić, M., Miltojević, A., Rajković, J. and Mihajilov-Krstev, T. (2011). Antistaphylococcal activity of *Inula helenium* L. root essential oil: eudesmane sesquiterpene lactones induce cell membrane damage, *European Journal of Clinical Microbiology & Infectious Diseases* **31**(6): 1015–1025.

Sutovska, M., Nosalova, G., Franova, S. and Kardosova, A. (2007). The antitussive activity of polysaccharides from *Althaea officinalis* L., var. *robusta*, *Arctium lappa* L., var. *Herkules*, and *Prunus persica* L., Batsch., *Bratislavske Lekarske Listy* **108**: 93–99.

Tsioutsiou, E. E., Giordani, P., Hanlidou, E., Biagi, M., De Feo, V. and Cornara, L. (2019). Ethnobotanical study of medicinal plants used in Central Macedonia, Greece, *Evidence-Based Complementary and Alternative Medicine* **2019**: 1–22.

Turrill, W. B. (1949). Laurentia in the Balkan Peninsula, *Kew Bulletin* **4**(1): 22.

Turudija-Živanović, S., Stevanetić, S., Ćeranić, S. and Živanović, T. (2014). Trends in production of raw medicinal and aromatic plants in Serbia, *Proceedings of the Fifth International Scientific Agricultural Symposium „Agrosym", Jahorina, 23-26 October*, pp. 1106–1111.

Veselinović, J. B., Veselinović, A. M., Nikolić, G. M., Pešić, S. Z., Stojanović, D. B., Matejić, J. S. and Mihajilov-Krstev, T. M. (2014). Antibacterial potential of selected 4-phenyl hydroxycoumarins: integrated *in vitro* and molecular docking studies, *Medicinal Chemistry Research* **24**(4): 1626–1634.

Šarac, Z., Matejić, J. S., Stojanović-Radić, Z. Z., Veselinović, J. B., Džamić, A. M., Bojović, S. and Marin, P. D. (2014). Biological activity of *Pinus nigra* terpenes - Evaluation of FtsZ inhibition by selected compounds as contribution to their antimicrobial activity, *Computers in Biology and Medicine* **54**: 72–78.

Šarić Kundalić, B., Dobeš, C., Klatte-Asselmeyer, V. and Saukel, J. (2010). Ethnobotanical study on medicinal use of wild and cultivated plants in middle, south and west Bosnia and Herzegovina, *Journal of Ethnopharmacology* **131**(1): 33–55.

Šarić Kundalić, B., Mazić, M., Djerić, S. and Kerleta-Tuzović, V. (2016). Ethnobotanical study on medicinal use of wild and cultivated plants on Konjuh mountain, North-East Bosnia and Herzegovina, *Technics Technologies Education Management* **11**(3): 208–221.

Šavikin, K., Zdunić, G., Janković, T., Gođevac, D., Stanojković, T. and Pljevljakušić, D. (2014). Berry fruit teas: Phenolic composition and cytotoxic activity, *Food Research International* **62**: 677–683.

Šavikin, K., Zdunić, G., Menković, N., Živković, J., Ćujić, N., Tereščenko, M. and Bigović, D. (2013). Ethnobotanical study on traditional use of medicinal plants in South-Western Serbia, Zlatibor district, *Journal of Ethnopharmacology* **146**(3): 803–810.

Vujanović, M., Majkić, T., Zengin, G., Beara, I., Cvetanović, A., Mahomoodally, F. and Radojković, M. (2019). Advantages of contemporary extraction techniques for the extraction of bioactive constituents from black elderberry (*Sambucus nigra* L.) flowers, *Industrial Crops and Products* **136**: 93–101.

WHO (2000). General guidelines for methodologies on research and evaluation of traditional medicine (document reference WHO/EDM/TRM/2000.1), World Health Organization: Geneva.

Yarnell, E. (2018). Herbs for viral respiratory infections, *Alternative and Complementary Therapies* **24**(1): 35–43.

Zarzuelo, A. and Crespo, E. (2002). The medicinal and non medicinal uses of thyme. in thyme. the genus thymus, *in* E. Stahl-Biskup and F. Saez (eds), *Medicinal and Aromatic Plants Industrial Profiles*, Taylor and Francis, New York, pp. 263–292.

Zlatković, B. K., Bogosavljević, S. S., Radivojević, A. R. and Pavlović, M. A. (2014). Traditional use of the native medicinal plant resource of Mt. Rtanj (Eastern Serbia): Ethnobotanical evaluation and comparison, *Journal of Ethnopharmacology* **151**(1): 704–713.

Zorić, M., Kostić, S., Kebert, M., Kladar, N., Božin, B. and Orlović, S. (2020). Volatile organic compounds of *Tilia cordata* Mill. from Serbia, in terms of ecosystem services, *Topola* **206**: 21–28.