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## **INCREASED DEMANDS FOR NATURAL IMMUNO- BOOSTERS IN SELECTED TOURISM AREAS**

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### **Abstract**

*Rural areas have been facing distinctive challenges during the COVID-19 pandemic. As in other parts of the world, in the Republic of Serbia noticed movement of people from places with high concentration of settlements, like cities, into less densely populated communities. Searching for rural, natural, wild areas far away from cities, tourists made different pressures on local environment (sound, litter, pressure on natural resources, pollution) but also increased demands for healthier way of living in accordance with World Health Organization recommendation during the Covid 19 period. Besides a clear environment, they would like to enjoy locally produced food and wild edible plants as a source of minerals, vitamins and other functional substances for strengthening immunity. Using standard botanical questionnaire, the research was conducted in selected rural areas with the aim to create a list of the most wanted wild edible plants by tourists and to overview their potential contribution to immune system strengthening in the COVID-19 pandemic period.*

Key Words: *wild edible plants, tourist mobility, COVID-19*

JEL classification: *I12, Q57*

### **Introduction - Covid-19 basic information and pandemic impact on movement habits (from urban to rural)**

The global response to the COVID-19 pandemic, based on previous experiences from other epidemics, is an activated R&D plan to accelerate diagnosis and therapy with research and development of a coronavirus

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vaccine. The two main goals are after the discussion on February 11 and 12 at the World Health Organization headquarters in Geneva on critical issues are defined. The first goal is to improve patient care and accelerate research in innovative technologies. The second goal is to define and support research priorities. A very important thing is the timely sharing of valid information between countries (World Health Organization, 2020). A vast number of pneumonia were emerged in Wuhan at the end of 2019, and at the beginning of 2020, a new virus was identified as the cause of pneumonia known such as (SARS-CoV-2) (Huang et al, 2020). In the February 2020 the illness caused by the SARS-CoV-2 virus was named by WHO officials as "COVID-19", and by third month of the same year when more than 100 countries were involved with more than 100,000 cases and several thousand dead a pandemic was declared by the WHO (World Health Organization, 2020). SARS-CoV-2 is crown-like RNA virus (Perlman & Netland, 2009).

The SARS-CoV2 virus has probably a natural and zoonotic origin. Natural selection in humans is taking place before zoonotic transfer (Lu et al, 2020). The clinical picture may be asymptomatic or severe (Phan, 2020). A serious clinical picture may require artificial ventilation and this may be associated with sepsis, septic shock and multi-organ damage (Lupia et al, 2020). The typical manifestation of this disease is pneumonia characterized by difficulty breathing, high temperature, cough and typical bilateral infiltrates seen on chest scans. Symptoms may include sneezing, red throat, and headache. Less frequent occurrence symptoms were rhinorrhea, sore throat, headaches, nausea and diarrhea in some patients. Person-to-person contact was the main way of disease transfer (Lupia et al, 2020).

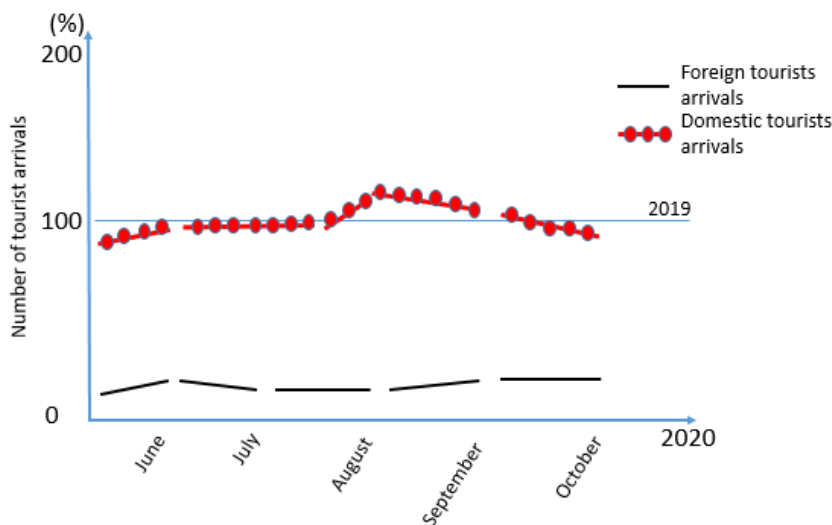
In addition to the symptoms of the respiratory and digestive tract (World Health Organization, 2020), the severity of the clinical picture is also affected by comorbidities (chronic obstructive pulmonary disease, high blood pressure, fatness and diabetes mellitus (Sanyaolu et al, 2020).

Cities are primarily, due to the high concentration of people, vulnerable to natural and man-made disasters and their impacts (Sharifi, 2020). Many times in history, cities have been hit by pandemics, so that made urban vulnerability as a current research topic. Climate changes and human influences to environment may be a factor of pandemics frequency increasing in the future so adaptation measures and necessary preparation is needed (Connolly et al., 2020). It is important to understand how this can

affect cities during pandemics and what measures are important for decreasing of its impacts.

The new coronavirus pandemic brings serious changes around the world in terms of way of living and working. The biggest innovations reflect to the jobs in the sense of remote work like never before in history, with almost seven of ten workers were included in this transformation. According to "Coronavirus Moving Study" (Bowman P.C., 2021) it was documented that people localize public locomotion with strict distance level between each other in order to stop virus spreading. Daily activities were reduced to mandatory like school, shopping, hospital visit etc. The whole new modality of living based on internet connection. Bearing in mind this moving phenomenon and remotely job options, people could afford themselves to leave crowded cities and move to the less density areas such as rural places.

Figure 1: *Number of tourist arrivals in 2020 compared to the same months in 2019*



Source: *Authors (According to available data in Monthly statistical bulletin)*

According to Monthly Statistical Bulletin data for 2020, it is evident declining trend in foreign tourists arrivals in the Republic of Serbia for about 80% related to same months in 2019, but also it is noticeable increase

in local movements. During August and September happened sudden increase (about 20%) of domestic tourist's arrivals in national touristic destinations, especially in rural areas. Caused by closed borders for travel or fear of travelling abroad, domestic tourists decide to spend most of time in the country destinations.

### **Return to herbal traditional immune boosters in the pandemic period**

During the last year, the world and the entire tourism industry faced the COVID-19 pandemic, which has spread across 206 countries. Although COVID-19 significantly influenced global tourism with tourist journeys decrease 60–80% during 2020 (UNWTO, 2020), local tourist mobility increased. People from cities find "health refugees" in rural areas to escape virus and boost immunity. Many human activities (e.g. changes in coastal or sand dunes tourism areas, etc.), affected by different natural and social factors, like ecological disturbances or demographic pressure (Šilc et al., 2020), rural areas as well as faced to sudden changes (litter pollution increased or impact on plant resources) caused by people movement phenomenon.

Public health and safety measures were recommended by the WHO over the world. Besides a range of measures from a high level of hygiene to face mask or self-management to minimize physical contact among each other, isolate and screen the infected people during initial stages, there is set of applicable measures to boost immune system. During the beginning of pandemic, was lack of approved drug therapy, lack of vaccines and people start searching alternative way to strengthen immunity. One group of people used recommended vitamins or minerals artificial supplements, while on the other side people decide to raise immunity staying in natural environment, far away from cities and using domestic food based on traditional knowledge. In last year, from the beginning of pandemic till now there are numbers of articles dealing with increased demand for herbal medicine. The focus were on confirm tradition medicine procedure like Ayurveda, Chinese medicine, wild edible plants in terms of respiratory system improving, plants rich in minerals and mixtures of plants with other compounds (honey, fungi, beverages). According to global report on wild plant trade (Timoshyna et al., 2020), during the initial COVID-19 pandemic period was noticed the increased interest for wild plants as herbal compounds in Traditional Chinese Medicine formulations and other herbal products around the world. This report indicate that from the beginning of pandemic period in China, 80% of natural products are based on wild

plants, and one of studies estimate 125 plant based products in COVID-19 treatment. It is evident that volume of use and trade with wild herbs increased in last year. Between used plants it is found number of threatened (11%) with extinction in the wild based on IUCN Red List criteria (IUCN, 2018).

Traditional Indian plant based medicine (e.g. Ayurveda, Yoga and Unani, Siddha, Naturopathy and Homeopathy, acr. AYUSH) play important role in global herbal therapeutic sector (Ravishankar & Shukla, 2007; Gomathi et al., 2020; Khanna et al., 2020). By official India Ministry of AYUSH it was suggested to consummate plant based extracts such as Kadha or Sunthi for strengthening immune system. Also, it was recommended to use several plant species with potential prevention effect on COVID-19 such as *Zingiber officinale*, *Syzygium aromaticum*, *Piper nigrum*, *Curcuma longa*, *Cydonia oblonga*, *Andrographis paniculata*, *Zizyphus jujube*, *Cordia myxa*, *Tinospora cordifolia*, etc. (Khanna et al., 2020). The most of the mentioned plants have effect on respiratory infections, immune reaction, enhancing antioxidant, for chronic fever, and cold, anti-allergic or anti-influenza activity.

Chinese traditional medicine suggesting utilization of herbal extracts from *Azadirachta indica*, *Camellia sinensis*, *Ocimum sanctum* and *Agremone mexicana*, *Zingiber officinale*, *Tinospora cordifolia*, *Alium sativum*) and *Ocimum basilicum* etc. with confirmed antimicrobial effect (Gupta et al., 2017; Varshney et al., 2013; Khanna et al., 2020). While *Exocarpium Citri grandis*, traditional Chinese herb, was found as very efficient in prevention or treating infections caused by COVID-19 (Khanna et al., 2020).

Despite limited success in finding effective therapy, using wild plants is increased trend, especially in low income countries, but COVID-19 treatment is still unproven and without scientific base or from clinical results. In electronic media, was appeared information on healing effects of *Artemisia annua*. This plant is rich in range of bioactive compounds, and with confirmed positive effect on uncomplicated malaria disease, but its effect on COVID-19 infections is not approve and require further researches (Kapepula et al., 2020). The World Health Organization (WHO) warns that the effects and nus-effects of medicinal plants, such as sweet wormwood (*Artemisia annua*), which have recently been advertised as a potential medicine for COVID-19, need to be investigated. The WHO emphasizes that it supports the scientifically proven efficacy of traditional

medicines and adds that complementary and alternative medicine have numerous advantages in the treatment of various diseases.

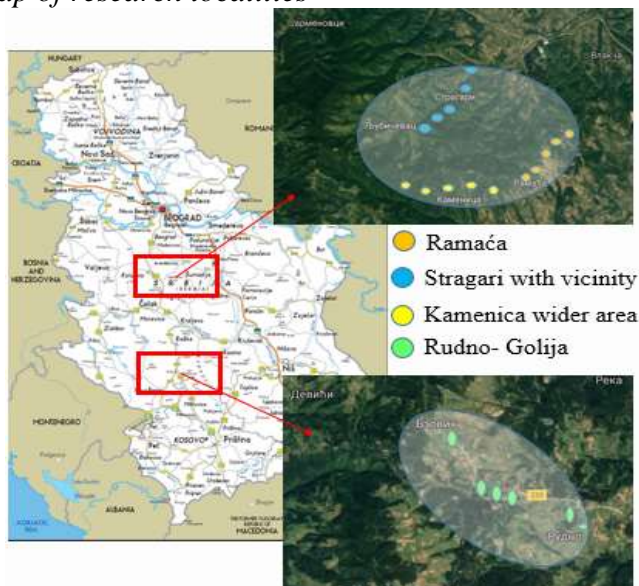
### Research methodology

The research methodology was a combination of literature data collecting, analyzing and comparing gained ethnobotanical survey results with similar researches.

### Study area

The fieldwork research was conducted from June to autumn season 2020 in Šumadija region and Golija Mountain. These areas include 4 villages distributed in attractive mountains: Rudnik slopes and Golija-Radočelo (Figure 1). Chosen villages (Ramaća, mountain villages of Stragari, wider area of Kamenica and Rudno with surroundings) have long history and knowledge in wild herb collecting, and also in the early phase of tourism development in Šumadija region and well developed tourism infrastructure in Golija mountain. During the last year, number of inhabitants significantly increased in both areas and made pressure on natural resources.

Figure 1: Map of research localities



Source: *Authors*

During the research it was spreaded 57 ethnobotanical questioners. The survey includes tourists and persons with temporary residence in targeted areas. Questioner aim to document wild plant species that are frequently used in period of COVID-19 pandemic as a tool for the improvement of immunity and diminishing potential virus deseases.

### **Data analysis**

The collected ethnobotanical data were quantitatively analyzed using indices of Relative Frequency Citation (RFC). This index shows the local importance of each species and it is given by the frequency of citation (FC, the number of informants mentioning the use of the species) divided by the total number of informants participating in the survey (N-57), without considering the use categories. This index mostly used in different ethnobotanical studies (Appiah et al., 2017; Bano et al., 2014 etc.)

$$RFC=FC/N (0<RFC<1)$$

According to the value of RFC, 17 wild plants and 4 natural based products with the highest frequency number were selected and a table with species list and literature data of traditional/current use was created (Table 1).

### **Results**

#### **The most frequently used plants/products by tourists in the pandemic period**

It is known that approximately 390 000 species of vascular plants distributed around the globe, while 60 000 of total plants are evaluated with potential use for medicinal purposes, and finally almost 26 000 have well-documented healing effect. Nearly 3 000 plant species (10%) of these are in the international trade market. Along the global geographic gradient and economic sectors about 60–90% of these species are wild-collected, and not in commercial cultivation (Timoshyna et al., 2020). The Balkans represent one of the most important vascular plant diversity centers counting 6340 species, in comparison to Europe it is about 50% of total European flora (Šavikin et al., 2013). In Serbian centuries old folk traditions, more than hundreds of plants were used as food, beverage, herbal medicaments, natural dyes, additives, and food preservatives, as well as textile or fibers, shelter or fuel, for traditional customs, religious purposes, and magical rites (Dajić Stevanović et al., 2014).

Table 1: High frequently wild plants/natural products use

Species	Eng./Local name	RFC	Purpose of use by informants
<i>Achillea millefolium</i>	Yarrow/ Hajdučka trava	0,47	Tea, mixed with honey
<i>Allium ursinum</i>	Wild garlic/ Sremuš	0,68	Fresh salads, processed food
<i>Althaea officinalis</i>	Marsh-mallow/ Beli slez	0,43	Tea, throat rinsing
<i>Carum carvi</i>	Caraway, cumin/ Kim	0,36	Spice, tea
<i>Cornus mas</i>	Cornel/ Dren	0,75	Juice, jam, fresh
<i>Matricaria chamomilla</i>	Chamomile/ Kamilica	0,42	Tea, addition to juice
<i>Melissa officinalis</i>	Motherwort/ Matičnjak	0,52	Tea, fresh, with honey
<i>Mentha piperita</i>	Mint/ Nana	0,59	Tea, salads, addition to sweets
<i>Origanum vulgare</i>	Oregano/ Vranilova trava	0,48	Spice, tea, processed food
<i>Rosa canina</i>	Dog rose/ Šipak	0,63	Jam, tea, fresh, addition to meat
<i>Teucrium montanum</i>	Mountain/ germander Trava Iva	0,29	Tea, spice, mixture
<i>Thymus vulgaris</i>	Thyme/ Majčina dušica	0,63	Fresh addition to salads, tea, spice
<i>Valeriana officinalis</i>	Valerian Root/ Odoljen	0,26	Tea
<i>Pinus nigra</i>	Black pine/ Crni bor	0,49	Tea, with honey
<i>Urtica diorica</i>	Nettle/ Kopriva	0,74	Processed food, juice, tea
<i>Sambucus nigra</i>	Black elder/ Zova	0,70	Juice
<i>Taraxacum officinale</i>	Dandelion/ Maslačak	0,57	Fresh salads, honey, tea
<b>Other</b>			
<i>Allium sativum</i>	Garlic	0,91	Range of use, food, fresh, spice
Commerical spices	/	0,85	Spice, addition immune drinks, tea
Edible Fungi	/	0,80	Processed, tea, jam
Local-growing salads	/	0,75	Addition to food, fresh salads

Source: Authors

According to results, the most frequently used plant species are *Urtica diorica*, *Allium ursinum* and *Sambucus nigra*, while the highest RFC index have a group of commercial and affirmed wild/domestic product with safe and known use procedure (Table 1). *Allium sativum* (garlic) is traditionally



trusted more than any other plant, the most important folk prophylactic, spices, and also known as the "food of the poor" in the Serbian history (Dajić Stevanović et al., 2014). Under the influence of the media range of commercial spices (*Cinnamomum verum*, *Zingiber officinale*, *Curcuma longa*, *Elettaria cardamomum* etc.) daily were used as fresh drinks with lemon, honey or addition to tea. Between interviewed tourists the most of them mentioned possession of knowledge in fungi collecting and processing. They rather use known and proven species like *Cantharellus cibarius*-lisičarka, *Amanita caesarea*-blagva ili jajčara, *Boletus edulis*-hrastov vrganj, as well as very healthful *Ganoderma lucidum* as tea.

The skills of traditional use of plants and processing is based on local knowledge and available information. Tourists show great interest in wild plant collecting, processing and use for changing life habit. Besides the most frequently used wild products, with high RFC were mentioned range of wild berries and its use (blackberry, raspberry, blueberry, chokeberry - fresh, salads, sweets, juice, smoothie, jam, liqueur etc.). Like global data shows (Timoshyna et al., 2020), new pandemic trend in Serbia has made significant pressure on natural resources in searching immunity boosters.

### **Medicinal effects of selected plant species**

For resisting viruses the immune response is very important and immune system mediators play a significant role (Calder et al., 2020). Hydrophobic binding, shown through the effect of lipophilicity, is the result of water molecules interacting after they leave the nonpolar surface (Stojanović et al., 2020). Mathematical analysis was important for optimization and individualization of the methods we used (Rosic et al., 2011).

The use of fat-soluble vitamins (A, D, E, K), vitamin C, minerals and trace elements are important in the fight against viruses (Gunville et al., 2013).

Vitamin A and D have an important influence on humoral immunity (Patel et al., 2019). The combined effect of vaccination and Se is significant in the fight against influenza (Ivory et al., 2017). Vitamin A is important for the regulation of vision, epithelial integrity, maturity and growth (Huang et al., 2018). Vitamin C as one of the important enzymatic cofactors and antioxidants is essential for boosting immunity (Kim et al., 2013).

Zinc affects the regulation of the immunomodulatory response (Read et al., 2019), the differentiation and growth of immune cells is affected by

copper (Li et al., 2019), selenium with his anti-inflammatory and antioxidative role (Rayman, 2012) were important for enhanced cellular immune response. Low concentrations of Se are associated with increased mortality, while higher concentrations have an antiviral effect (Rayman, 2012).

The group of medicinal plants that have been most studied includes garlic, and in addition to it, other plants that are a significant source of minerals and are therefore important for nutrition.

Garlic has several pharmacological effects: it acts against bacterial infections (its action as a powerful natural antibiotic does not affect the flora of our body), acts against intestinal parasites, has the role of antioxidant (neutralizes the action of free radicals and thus prevents dementia and premature aging), antispasmodic (relieves cramps, convulsions and muscle spasms), has anticancer effect, acts as an anticoagulant (prevents the formation of blood clots), has an antiseptic effect (destroys pathogenic bacteria and prevents their growth), has an antitumor effect (inhibits the formation of tumor cells), destroys viruses, has a beneficial effect on the digestive system, has a diuretic effect, acts as an expectorant (facilitates the expulsion of secretions from the respiratory tract), lowers fever, stimulates tissue activity. For medical purposes, we use: garlic oil, dried and fresh bulbs (Tattelman, 2005).

*Althaea officinalis* is traditionally used for the treatment of the irritation of oral, pharyngeal mucosa and associated dry cough, gastritis, skin burns and bites made by insects. Pharmacological effects of *Althaea officinalis* were: antimicrobial activity, antiinflammatory and antitussive effects (European Medicines Agency, 2009). Part used: Leaf, root, flowers

Wild garlic (*A. ursinum*) is mostly used for the prevention and treatment of infections and cardiovascular diseases. It has been proven to have a significant reduction in serum lipids and cholesterol, as well as a reduction in high blood pressure, inhibits platelet aggregation and prevents progression of atherosclerosis (Sobolewska et al, 2015). Many studies point to the fact that wild garlic can be used for treatment bacterial and fungal infections (Mihaylova et al, 2014). Allicin is a substance contained in this plant, to which these properties are attributed (Sobolewska et al, 2015).

In men who have adenoma or prostate cancer, nettle root extract (*Urtica dioica*) reduces nocturia (Musette et al, 1996). Specific *Urtica dioica*

agglutinin (UDA) causes the inhibition of HIV-1 and 2, influenza A and respiratory syncytial virus (Gansser & Spiteller, 1995). It also affects systemic lupus erythematosus by inhibiting its development (Farzami et al, 2003). Aqueous extract of nettle leaves has an effect on diabetes, which has been proven in studies (Riehemann et al, 1999). So, this plant not as just a simple weed.

### Conclusion

Forced by pandemic circumstances, people moving from cities to less density areas. Reasons for moving in pandemic period are different: available online jobs, classes, escape infection, less contacts, as well as wide range of advantages of natural environment. Besides other habits that were changed during the pandemic period, tourists changed their nutritional patterns aiming to strengthen the immune system. According to questioner, the most used natural boosters were traditionally known wild plants and local products such as *Allium sativum*, *Urtrica diorica*, *Allium ursinum* and *Sambucus nigra* or a range of spices, salads, berries prepared in traditional way in the forms of juice, jam, liqueur, tea, fresh or addition to processed food. All these products have specter of vitamins, minerals or other compounds –nutraceuticals important for immune system. It is expected that new tourist's food demands will have a future effects on local rural gastronomy offer.

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