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# Agrobiodiversity and health safe food production

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**ABSTRACT**

*Agrobiodiversity, as the variety of plant, animal and microorganism species within the agroecosystem, is a key factor in preserving sustainable and safe food systems. The paper studies the connection between agrobiodiversity and food production, with special reference to the influence of genetic and species diversity on the nutritional quality and food health safety. Using an analytical and comparative approach, the paper examines how the loss of agrobiodiversity, caused by intensive agricultural production and other anthropogenic influences, negatively effects on food health safety. The results indicate that the preservation of local varieties, soil biogenicity and production based on ecological principles not only contribute to food safety, but also increase crop resistance to diseases and pests. Based on the analysis, it is recommended to strengthen institutional support, raise the awareness of producers and consumers, as well as develop tendencies that include production based on ecological principles with the aim of preserving the environment, agrobiodiversity and food health safety. The conclusion is that agrobiodiversity is not only an ecological, but also a health and economic resource of strategic importance for food production in the future.*

***Keywords:*** *agrobiodiversity, biotechnology, food health safety, sustainable agriculture, public health.*

## INTRODUCTION

Modern challenges in the field of food production, climate change, land degradation and loss of biological diversity are increasingly raising questions about the sustainability and security of the global food system. In this context, agrobiodiversity, which includes the diversity of plant, animal and microbiological species used in agriculture, becomes a key tool for preserving the resilience of agroecosystems and improving food health safety. Food safety means the availability of food that is of good nutritional quality, safe for consumption and produced in accordance with the principles of sustainability. However, intensive agriculture, oriented towards monocultures and the use of chemicals, often threatens the diversity and functionality of ecosystems, which can have negative consequences for human health and food safety. The connection between agrobiodiversity and food health safety is not only ecological, but also socio-economic. Preservation of

local varieties, soil biogenicity, production based on ecological principles and the application of sustainable agricultural practices contribute to a more diverse diet, greater crop resistance to pests and diseases, as well as reducing the risk of food contamination during production. Precisely because of this, the understanding and valorization of agrobiodiversity is a key step towards a safer food production system (Đukić et al., 2007; Popović, 2015; Šarčević-Todosijević et al., 2024a).

This paper aims to analyze the role of agrobiodiversity in preserving the food health safety, to point out the challenges and potentials it provides, as well as to point out the possibilities of improving tendencies and practices that would enable the harmonious development of agriculture and the preservation of public health.

## AGROBIODIVERSITY AND HEALTH SAFE FOOD PRODUCTION

According to the definition of the "Convention on biological diversity" (United Nations, 1992), biodiversity or biological diversity represents the diversity of all living organisms on the planet. The term biodiversity includes three levels of biodiversity: gene level - genetic diversity, species level - species diversity and ecosystem level - ecosystem diversity. Genetic diversity represents the set of genes of all existing living beings on the planet, since each organism is a unique combination of genes. All species on the planet, from the beginning of life until today, represent species diversity. About 1.7 million biological species have been determined so far. Ecosystem diversity represents the diversity of habitats, biocenosis, as well as all processes carried out by organisms within the ecosystem (Šarčević-Todosijević et al., 2018, 2019a, 2025).

Species diversity means the diversity of all living species that have existed on Earth since the beginning of life until today. Scientific estimates show that even about 99% of all species that once existed have disappeared during geological history, while today's species make up only about 1% of the total number. Some extinctions occurring naturally and others being accelerated by human activities. The term species diversity includes not only the number of different species, but also the diversity within species themselves – including differences between individuals, seasonal changes, different behavioral patterns, phenotypic differences and other forms of biological diversity (Janković, 1995; Stevanović and Janković, 2001; Amidžić, 2020).

From the aspect of species diversity protection, it is particularly important to mention the *Picea omorika* plant species (Figure 1). *Picea omorika* is a Tertiary relic, a species for which there are certain paleontological findings that it lived at the end of the Tertiary. The Tertiary Period began about 66 million years ago with a mass extinction biological species. *Picea omorika* is also an endemic of the Balkan Peninsula because it grows wild only in a narrow area around the middle course of the Drina, on mountain Tara. It is protected by law. The Balkan Peninsula is a biodiversity hotspot, with numerous endemic species, especially plants and animals. Many endemic plants belong to families like Asteraceae, Caryophyllaceae and Fabaceae, with genera like *Hieracium*, *Dianthus* and *Centaurea*, three distinct genera of Magnoliophyta (flowering plants) (Janković, 1995; Amidžić, 2020; Jančić, 2004).

In addition to wild species, part of the global biological diversity is made up of domesticated, i.e., cultivated species, which together constitute agrobiodiversity. Agrobiodiversity includes all microorganisms, plants and animals that are key to the functioning of agroecosystems, food production and ensuring food health safety (FAO, 1999). Today, over 7000 plant species are cultivated worldwide, including a large number

of different varieties, as well as a significant number of domestic animal species, which include widespread and local breeds (Scherf, 2000). In Serbia, a large part of the total biological diversity consists of cultivated plant and animal species, which represent an important genetic resource (Figure 2). A large number of plant species are cultivated, including cereals, industrial and fodder plants, vegetables and fruits, as well as grapevine (*Vitis vinifera* L.). Within these species there is great genetic diversity - from modern varieties to ancient and local populations, wild relatives of cultivated plants and selection material within each cultivated species. Agricultural institutions in Serbia store about 25000 seed samples of old varieties and local populations. Many of the cultivated plants have wild relatives, which grow wild in natural ecosystems. Wild relatives of apple (*Malus sylvestris*, *Malus florentina*, *Malus dasyphylla*), pear (*Pyrus communis*, *Pyrus amygdaliformis*), plum (*Prunus cerasifera*, *Prunus spinosa*), cherry (*Prunus avium*), the European dwarf cherry (*Prunus fruticosa*), walnut (*Juglans regia*), almond (*Prunus amygdalus*), hazelnut (*Corylus avellana*), chestnut (*Castanea sativa*), raspberry (*Rubus idaeus*), red currant (*Ribes petraeum*, *Ribes multiflorum*), strawberry (*Fragaria vesca*, *Fragaria viridis*, *Fragaria moschata*) and other cultivated species often grow in nature. About 700 species of autochthonous flora of Serbia can be classified in the group of medicinal and aromatic plants, of which 400 species are cultivated. There are also a large number of species of honey plants, as well as numerous ecosystems important for the pollinator conservation, which makes a special contribution to agricultural production (Janković, 1990, 1995; Popović, 2015; Amidžić, 2020).

**Figure 1.** Species diversity - *Picea omorika*, Tertiary relict and endemic species of the Balkan Peninsula (author's collection)

**Figure 2.** Agrobiodiversity - cultivated plant species (author's collection)

Agrobiodiversity can also be seen through the number of newly created and local varieties of plants, including domestic autochthonous and foreign varieties that have adapted to local conditions. Foreign plant varieties refers to those that are not native to a particular region, but have been introduced or grown in that area. There are about 5000 varieties on the national list of plant varieties, which are classified into the following groups: small grains and corn, industrial plants, fodder plants, vegetables and fruits and grapevine, as well as aromatic, spice and medicinal plants (Popović, 2015). Successful production of soybean (*Glycine max*) is achieved by choosing high-yielding varieties and appropriate production technology. At the "Institute of Field and Vegetable Crops" in Novi Sad, 129 NS soybean varieties were created and registered and a significant number are also on the EU list. Soybean produced in the Republic of Serbia is not genetically modified, which ensures the safety of export to the world market (Živanović and Popović, 2016). Due to the favorable chemical composition of the grain (about 40% protein and about 20% oil), soybean is one of the most important leguminous plants used in nutrition. It is also used for medical purposes and in the pharmaceutical industry (Kovačević, 2004). Intake of fruits, vegetables and grains can reduce the risk of chronic diseases, mainly due to plant compounds that act as antioxidants. These compounds, primarily polyphenols, but also other products of plant metabolism, help reduce oxidative stress in cells, which can damage DNA, lipids and proteins and cause degenerative diseases. In this way, plant metabolites play an important role in the prevention of cancer and cardiovascular diseases (Kovačević, 2004; Šarčević-Todosijević et al., 2024b).

In addition to intensive use in a healthy and balanced diet, numerous plant species from the national list produce biologically active secondary metabolites, which have great potential for use as drugs in medicine and pharmacy, but also as biopesticides in health safe food production. The biological phenomenon of allelopathy is the basis of the application of

these substances in health safe plant production. Allelopathy is an ecological interaction, in which one organism produces chemical substances - allelochemicals, which affect other organisms in the environment. These substances can help or harm other organisms by affecting their germination, growth, survival and reproduction. Allelochemicals include acids, alcohols, lipids, terpenes, aromatic and other compounds. The use of the plant species *Pyrethrum cinerariifolium* has been known for a long time. It is a perennial herbaceous plant, up to 1 m tall, belonging to the Asteraceae family. It contains a mixture of monoterpene esters in a total amount of 0.4–2%. These are esters of cyclic keto-alcohols and monocarboxylic or dicarboxylic acids. In addition to esters, *Pyrethrum cinerariifolium* also contains about 0.3% of essential oil, sesquiterpene lactones, resins and waxes. Ester compounds act as contact neuromuscular poisons or neurotoxins (Figure 3). These are substances that disrupt the communication between nerves and muscles, leading to muscle weakness or paralysis. These poisons can originate from various sources, including animals, plants, and bacteria, as well as being developed synthetically. Pyrethrin I is the most effective. The powdered inflorescence of *Pyrethrum cinerariifolium*, drug extracts and isolated pyrethrins are used as highly effective contact insecticides. Resistance to these compounds occurs very rarely. The additional quality is contributed by the fact that they are not dangerous for animals and people (Kovačević, 2004, Šarčević-Todosijević and Malivuk, 2019; Šarčević-Todosijević et al., 2019b, 2024b; Popović et al., 2021; Golijan Pantović et al., 2023).

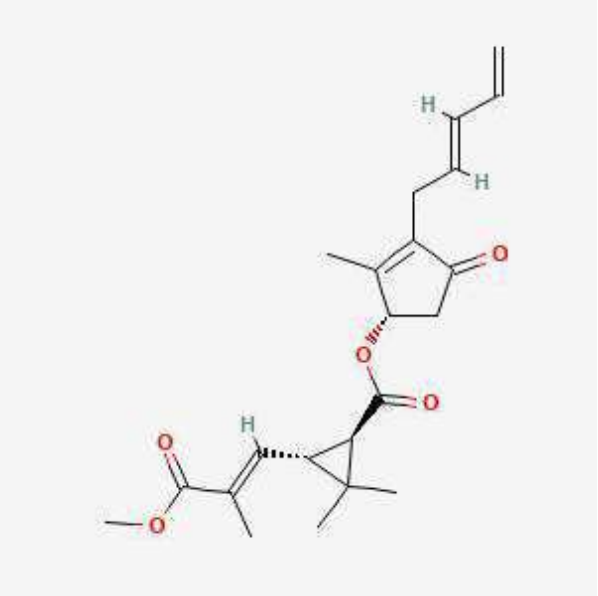


**Figure 3**. Pyrethrin - chemical structure
(source: *National Library of Medicine/National Center for Biotechnology Information,* https://pubchem.ncbi.nlm.nih.gov/compound/Pyrethrin)

Pollution of the environment, air, soil and water has extremely negative effects on biodiversity. Soil pollution has a negative effect on agrobiodiversity, and thus on the production of health safe food. Soil pollution occurs when its physical, chemical and biological properties change, which leads to a decrease in fertility and disrupts the natural processes of decomposition and circulation of substances. Such changes affect living organisms in the soil and disrupt the balance in ecosystems. The main causes of

degradation are agriculture, logging, mining, industry, urbanization, traffic and energy. Soil is polluted in different ways: acid rain, polluted water, excessive use of chemicals in agriculture, as well as disposal of various types of waste. Because of this, harmful substances accumulate in the soil that destroy useful organisms, interfere with natural processes such as the decomposition and absorption of nutrients, and through the food chain have a harmful effect on other organisms and the functioning of the entire ecosystem. Increased concentrations of metals and other pollutants disrupt soil metabolism and negatively affect the entire ecosystem (Đukić and Đorđević, 2004; Đukić et al, 2007, 2011; Šarčević-Todosijević et al., 2022).

The pursuit of higher profits and the excessive use of natural resources disrupt the natural balance and living conditions. Conventional agriculture has numerous negative consequences, such as the excessive use of chemical fertilizers, pesticides, antibiotics, growth stimulants, genetically modified microorganisms, which leads to the degradation of soil and other environmental components, deterioration of climate conditions, and endangering food health safety. Since soil is a limited and non-renewable resource, it is important to take measures to protect it. Numerous scientific studies have shown that nitrogen has the greatest influence on the yield of plants. However, the uncontrolled use of mineral nitrogen fertilizers leads to eutrophication and groundwater pollution, as well as pollution of soil and cultivated plants. Nevertheless, the results of a large number of scientific studies that confirm the justification of the use of microbiological fertilizers in order to achieve high yields and reduce the negative effects of mineral and organic fertilizers on the environment are encouraging. Plant nutrition depends on the biogenicity of the soil, as well as on the activity and number of microorganisms in the soil, so for successful and health safe plant production it is necessary to provide conditions for optimal microbiological processes. In this sense, preserving the biodiversity of soil microorganisms is the most important for the production of healthy food. Therefore, agroecology uses ecological principles to manage sustainable agricultural systems. In these systems, it is important to understand how environmental factors affect organisms, especially cultivated plants and soil microorganisms. This knowledge is crucial for preserving productivity, sustainable management and protection of the environment, especially soil, as well as for the production of healthy and safe food (Đukić et al, 2007; Popović et al., 2019, 2020, 2023; Golijan Pantović et al., 2023; Šarčević-Todosijević et al., 2024a).

## CONCLUSION

Preservation of agrobiodiversity is a key factor for sustainable agriculture and the production of healthy food. The diversity of plant and animal species enables the resistance of the agroecosystem to external influences, reduces the need for chemical agents and contributes to the preservation of soil and water quality. In modern conditions, in which challenges such as climate change, pollution and soil degradation are increasingly present, it is necessary to develop agricultural practices that support biological diversity and at the same time provide safe and nutritionally rich food. The integration of traditional knowledge with modern scientific approaches should be the basis of strategies for improving production and protecting the environment.

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