



**Slovak University of Agriculture in Nitra
Faculty of Agrobiolgy and Food Resources
Institute of Biodiversity Conservation and Biosafety
Department of Genetics an Plant Breeding
Excellent Centre for the Conservation and Sustainable Use
of Agrobiodiversity
Research Centre AgroBioTech**

and



**M.M. Gryshko National Botanical Garden of National
Academy of Sciences of Ukraine, Kyiv, Ukraine
Department of Fruit Plants Acclimatization**

Book of Abstracts

of the

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Conference**

**Agrobiodiversity for Improve
the Nutrition, Health and Quality
of Human and Bees Life**

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Arboretum and Institute of Physiography
in Bolestraszyce, Poland



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**Institutions and experts were actively involved in the organization
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and Quality of Human and Bees Life**

in the framework of

AgroBioNet

International Network

within the implementation of the International Program

'Agrobiodiversity for Improve the Nutrition, Health and Quality of Life'

in the form of solved research, education and development projects and research stays

Authors and author collectives present at the international conference in lectures,
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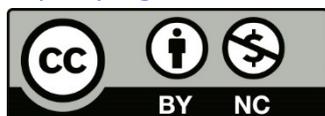
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Welcome to 4th International Scientific Conference

Dear Participants

For us, the organizers of the 4th International Conference 'Agrobiodiversity to Improve Nutrition, Health and Quality of Human and Bees Life', it is a great pleasure and as well as a great honour to welcome you to Slovakia, the ancient city Nitra and on the Slovak University of Agriculture in Nitra.

The Congress Centre of the Slovak University of Agriculture in Nitra will be the venue of scientific and academic discussions, presentations, interventions, confrontation of opinions, exchange of knowledge and experience, initialing new contacts and meetings of cooperating members of *AgroBioNet* International network.

The Slovak University of Agriculture in Nitra, represented by the Institute of Biodiversity Conservation and Biosafety and the M.M. Gryschno National Botanical Garden at the National Academy of Sciences of Ukraine in Kyiv, represented by the Department of Plant Introduction, initiated in 2013 the international conferences about biodiversity and agrobiodiversity and they want to continue and develop them.

The reason is very simple. The theme of International Conferences focused on the conservation and usage of agrobiodiversity to improve nutrition, health and quality of life is the foundation of the present civilization. Therefore, the issue brings together not only all-conference participants but also other botanists, researchers, breeders, seedsmen, growers, processors and other professions they recognize, using not only traditional plant species but also forgotten, less-used and less-known species for food security, food safety and resolving the other needs of civilization.

This is evidenced by the very extensive focus of the presented knowledge and results achieved in the solution of research and development projects of research and academic institutions processed in the form of abstracts in the submitted publication of this year's international conferences.

Researchers' efforts to conduct experiments aimed at preserving, identifying, evaluating, expanding and exploiting the unique phenomenon of biodiversity and the still undervalued use of agri-biodiversity are also evidence that, despite the lack of fund, technical equipment, and national governments understanding, researchers present extensive original knowledge and results.

On behalf of the organizers of this conference, we wish all participants a pleasant stay in Slovakia, in the city Nitra and at the Slovak University of Agriculture in Nitra. I wish to all authors and co-authors of the presented scientific publications a successful presentation in a creative atmosphere.

The International Conference organizers also thank all the other co-organizers of the international conference for their help and support!

Assoc. Prof. Ján Brindza
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ORAL PRESENTATIONS



BIODIVERSITY IN THE LIGHT OF CURRENT, FORGOTTEN AND FORBIDDEN SCIENCES

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The Convention on Biological Diversity is one of the most important international conventions in the field of the environment and the conservation of Life on Earth. It was first signed at the United Nations Conference on Environment and Development on 5 June 1992 in Rio de Janeiro, Brazil, and entered into force on 29 December 1993. The Convention objectives are 1) biodiversity conservation – protecting Life on Earth, 2) sustainable use of its components, and 3) fair distribution of benefits from the utilized genetic resources. The Convention is a very noble and necessary aim for the conservation and development of contemporary civilization. But what is the truth after 25 years of fulfilling these noble aims? With the participation of scientists and diplomats from 130 countries around the world, was realized a conference in Paris on April 29th 2019, which adopted the first global 1800-pages report on the state of Earth's ecosystems. More than 150 experts and tens of their collaborators were working on it for more than three years and reported: 'Up to now, the importance of biodiversity has been discussed, particularly from an environmental point of view. Now is forefront fact, that nature is the **'key to food production, clean water, medicine, and even social cohesion'**. Unfortunately, 'immediate acceleration of species extinction' is expected. It is endangered from half a million to a million species, and this will happen 'the next decades' for many species. **Humankind stands on the threshold of the sixth mass extinction of species, the first since the momentous birth of Humankind.** José Gregorio Mirabal, president of the indigenous community in the Amazon, expressed it very clearly 'Science tells us what our smart old men have been saying for decades: **The Earth is dying**'. George Bernard Shaw described this situation very briefly many years ago **'We are taught to fly in the air like birds, and to swim in the water like the fishes; but how to live on the Earth we don't know'**. Does it follow that nothing has improved in 25 years of implementation of the Convention?! How is it possible that the activities of *Homo sapiens* civilization, with all international organizations, scientific institutions, universities and researchers' intellectual potential, have shown positive effects only a minor extent? And continue to **'We are infringing the foundations of our economy, subsistence, food security, health and quality of life around the world'** (Watson, 2019). I do not consider myself a specialist in analyzing the state of conservation and use of biodiversity *versus* agri-biodiversity. As an ordinary inhabitant of this planet Earth, I also have the right to express at least my opinion on the complexity of the matter. Therefore, I would like to state my viewpoint. Conservation and utilization of biodiversity – means preserving Life in all its forms of diversity. It is a simple characteristic. But all forms of diversity of life are known to neither the scientific public nor the general public. Is the contemporary scientific community able to define the Life? The main difficulty in interpreting this very complex issue is that the large majority of the planet's inhabitants perceive life as such, only at a technocratic level, and the spiritually is disregarded. According to the latest evidence, there are 390 900 plant species registered on our planet. Almost 2,000 new species are registered every year, but the number of endangered species is also increasing. Civilization can use over 70,000 species at the level of agri-biodiversity, but in fact, it only uses around 7,000 species from those resources. The same state is for animal species of microorganisms. It is now well known that every object that is composed of atoms has its own Energy Field – commonly called an aura that can be changed by human word. So, where is the borderline between animate and inanimate matter called? In the Romanian region of Vâlcea, there are stones called trovants, which are evidently growing. For its uniqueness, this region is included in the UNESCO list of natural monuments.



There is evidence that the Universe is a living organism, as well as the Earth, is a living organism. Their vibration is proof! *'Everything in the world is vibration'* (Albert Einstein). It is scientifically demonstrated that so-called Schuman resonance of about 7.83 Hz current exists, but many leading scientists do not acknowledge it. *'Why?'* The synchrony between the Universe, Earth, and Mankind at the resonance level not only increase our awareness but also strengthens our health and affects many human activities. Man can survive 4–5 days without food but will die after only 2–3 days without water. Modern civilization respects water as ordinary matter. In 2017 the indigenous Māori in Tasmania convinced the government after 140 years of litigation that their longest Whanganui River would receive 'human rights – meaning it must be treated as a living entity'. The government regularised the Whanganui River with human rights as well as the Te Urewera National Park – as owned by Mother Earth. Who's right? Currently is proven that water has about 150 anomalous properties, many of which today's science cannot explain. The water is alive and dead, it has own memory, reacts to music, sound, words of man, feelings and health of man. It can be structured and activated in various ways, it absorbs the infrared radiation. Scientists have identified 14 water states in solid form and 5 in liquid form, but only 4 states are still reported in textbooks. Until now 17 types of ice have been described. Very interesting is the characteristic of intracellular water. Today's civilization lives in a 'poison era' using the most water-polluting synthetic chemicals. The residues of contraceptives, synthetic drugs, pesticides, detergents and cosmetics that get into the water every day are already in high concentration and cannot easily be removed. Japanese authorities have reported that the levels of radioactive iodine in the sea near Fukushima already reach 1250 times the permitted limit. Biodiversity and agri-biodiversity also form the fundamental of the nutrition of civilization. It is well known that food safety decreases considerably for various reasons. Is it possible to grow and produce organic food with a high level of safety?! Illustrative examples in this way are family farms that ensure production by the biodynamic system. R. Steiner introduced this system through his philosophy and teaching. The aim of biodynamic agriculture is to improve the vitality of plants and animals, increase soil fertility, produce healthy food, improve soil, an environment and improve the social status of the farmer. Around 4000 farms in over 40 countries are already using this system. Products from biodynamic agriculture are marked with mark 'Demeter'. The mark stands for certified quality from production to processing and trade. It is much stricter than all other environmental certificates. Such farms also fulfill a social function – a farm as a place of coexistence and therapeutic work for disabled or disadvantaged people. In modern terminology, this system is referred to as social farming. One of the basic aspects of this system is the so-called Bovis Vital Energy.

Keywords: biodiversity, agri-biodiversity, life, state of ecosystems, water characteristics, biodynamic agriculture, social farming.



45 YEARS OF IMPLEMENTATION PROGRAM ABOUT CONSERVATION AND USE OF AGROBIODIVERSITY IN THE INSTITUTE OF BIODIVERSITY CONSERVATION AND BIOSAFETY AND DEPARTMENT OF GENETICS AND PLANT BREEDING AT THE SLOVAK UNIVERSITY OF AGRICULTURE IN NITRE

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The solution program for conservation and use of agrobiodiversity began in 1974 at the Department of Genetics and Plant Breeding. In the first period, the focus was on studying the economic value and quality of the gene pool of registered varieties of summer wheat, peas, and potatoes. In 1991, the collective of Department of Genetics and Plant Breeding initiated a long-term research program called 'Conservation of Endangered Gene Pool of Plant Species in Slovakia'. In 1995, the program grew into the establishment of the Plant Genetic Resources Conservation Centre at the Department of Genetics and Plant Breeding. In 2002, the Centre was transformed into an independent establishment of the Slovak University of Agriculture, called the Institute of Biodiversity Conservation and Biosafety (hereinafter as the Institute). In 2005, the Institute was incorporated into the administrative structure of the Faculty of Agronomy and currently is integrated into the structure of the Faculty of Agrobiolgy and Food Resources. The establishment of a specialized centre has created the compartment and conditions for the realization of a research and training program for the biodiversity conservation, focusing on endangered plant species, agro-biodiversity and its sustainable exploitation in the plant breeding, seed production, agri-food, nutrition, rural development, biological and food safety and the conservation of natural and cultural heritage.

The Institute provides research, development, education and counseling activities at national and international level. For the previous period, the Institute and the Department of Genetics and Plant Breeding have coordinated a total of 59 research projects, including 3 at the international level within the research program, 6 integrated projects of applied character, 3 projects within the APVT-APVV program, 3 VEGA projects, 6 KEGA projects, 6 projects within the PPA, 2 development projects at the international level (NEWS – Nicaragua with Holland aSAMRS – in Serbia), 7 projects in the research form for a contract (Heineken, Slovakofarma Hlohovec, EL spol. s r.o. Spišská N. Ves., Algiwo, s. r. o. Lučenec) and 3 projects within the Structural Funds (ASFU aSIEA). At the same time, the Institute actively participated as a partner of 11 research projects solved within the TEMPUS program (2), ASFEU (3), state programs (4), VEGA (1), KEGA (1). The research objects in the projects were 51 traditional plant species, 87 underutilized species, and 46 less-known plant species.

As part of the scientific training in the 'Conservation of Sustainable Use of Agrobiodiversity', 28 graduates completed their doctoral studies successfully in both the full-time and the external form. More than 200 students were involved in the program solution in the form of a final diploma and bachelor thesis.

As part of the training program, the Institute coordinates and provides the Lifelong Education Program under the title 'Education for Each One and All'. More than 1700 participants attended specialized accredited courses in 9 focus areas. Many courses (AgroEduca – Tempus, BiodiversityEduca – Tempus, FarmersEduca and BeeEduca – Visegrad Fund and GMOEduca – UNDP) were implemented in the framework of international educational projects with financial support from various Agencies.

In its extensive publishing activities, the collective provided the publication of 98 titles of the textbooks of the Biodiversity Conservation edition, 71 professional publications, 8 annuals of the Genetic Plant Resources, 84 Proceedings from the conferences and seminars of Genotype edition, 7 classifiers, 13 methodologies, and other documents. Within the



framework of professional consultancy, the Institute provided preparation and publication of 27 e-textbooks and 6 e-specialized databases and catalogues.

The transfer of knowledge for the professional is ensured by the collective of the Institute by organizing cycles of conferences and seminars with many institutions. Collective organized the 6 editions of 'Natural Resources and Cultural Heritage of the Regions', 7 editions of 'Biosafety in Agriculture', 5 editions of 'Tokay Viticulture and Winemaking', 7 editions of 'Preservation Endangered Plant Genetic Resources in Slovakia', and 5 editions of seminars on the application of mathematical-statistical methods. Collective has organized 3 editions of International scientific conferences in cooperation with the M.M. Gryshko National Botanical Garden (Kyiv) about Conservation and Exploitation Non-traditional Plant Species, with the Institute of Phytotherapy at the National University of Uzhhorod 7 editions of Phytotherapy and Nutrition, as well as with the Centre of Organic Agriculture in Selenca in Serbia 4 symposiums about Organic Farming.

Throughout the period, the institute's collective provides extensive cooperation at the national (34 institutions) and international level with 38 institutions on the base of the contracts. The most important activities in this area are research stays of PhD students and researchers. 176 foreign participants with financial support from SAIA agencies, Visegrad Fund, Erasmus-world, Bilateral agreements, and others) have completed research stays from 1 to 40 months period.

The extensive results and knowledge of the research activities were presented by the collective in more than 500 professional papers, including 393 articles in cooperation with foreign authors. The collective of Institute received 6 awards at the national level and one award at the international level (FAO). In cooperation with partners from Ukraine, the staff of the Institute are co-authors of 6 common patents.

Extensive activity and mainly the international cooperation of the Institute already for 25 years has grown to a new level. Based on the initiation of the Institute and the decision of the Rector of the Slovak University of Agriculture in Nitra, Mr. h. c. prof. Ing. Peter Bielik and Director of the M.M. Gryshko National Botanical Garden at the National Academy of Sciences of Ukraine, Mrs. prof. Nataliia Zaimenko, Doctors of Botanical Sciences, they established in Memorandum signed in 2013 within the framework of the TRIVE project (ITMS 26110230085) the international AgroBioNet network for the realization of joint international research, education and development program 'Agrobiodiversity for Improving Nutrition, Health and Life Quality'. The network is already registered by over 200 experts and more than 30 institutions. With the establishment of this international network, the Institute has acquired a new form of a virtual platform with new possibilities for the realization of extensive activities in cooperation with many national and foreign institutions. For the presentation of extensive results and knowledge obtained from common resolved projects within the AgroBioNet network, the guarantors created the Proceedings of Scientific Papers entitled Agrobiodiversity for Improving Nutrition, Health and Life Quality in the *on-line* form.

Keywords: history, overview, activities, research, education, international cooperation, scientific publications, knowledge transfer for practice.



ETHOLOGY OF BEES BY USING DIFFERENT CONSTRUCTIONS OF HANGING POLLEN COLLECTORS

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Honey bees spend a lot of energy on the harvesting and processing of feed. External and internal factors can reduce or increase the physiological costs of bees, and accordingly affect the development and productivity of colonies. The fact that getting bee pollen slows the flying activity of bees. The reason for this is mainly the design features of devices – pollen collectors, and the specific behavior of bees in the area of the tray.

The purpose was to investigate the ethology of flying bees in the area of the airship and to improve the pollen collector. This will create the preconditions for improving the technology of obtaining bee pollen. The object of research was flying bees and the most prevalent in Ukraine designs of hanging pollen collectors. Three groups of bee colonies were used in the experiments (n=10): control – maintenance without pollen collectors; experiment 1 – installed on the bee homes pollen collectors with narrow-high gratings; experiment 2 – used pollen collectors with elongated grate.

In 2018, on the basis of two apiaries, it was recorded a video of the ethology of bees near the flying space in different periods of the day during two weeks. On the basis of these researches, the design of the hanging pollen collector was improved. The pollen collector prototype (10 devices) was printed on a 3D printer, the effectiveness of it was tested on the same apiaries in 2019. In the process of testing, the performance of devices was determined in comparison with analogues and was examined the ethology of bees.

According to the results of video registration, zones of intensive movement of bees on the flying board of bee homes were determined. It has been established that the bees flying out and flying to their nests move sufficiently in a narrow corridor – the flying zone, and in small quantities can be displaced 3–8 cm from it and are almost not delayed on the flying board or the lower part of the hull of pollen collector. Bees spend 20–30 % more time when pollen collectors are on, because of accumulations them near the central sections of the grids and complications when passing through their holes.

In the work zone of the pollen collector, it is proposed to use two gratings for removing bee pollen. They are placed in pollen collectors as a cone, which increases the area of openings for the passage of bees twice. The delineation of the bees' flows provides by a curtain that is installed in a corridor located at the opening of the flying place. The bees which are flying out emanate from the nest through the discharge tubes which located on the sides of the pollen collector.

For getting bee pollen is slowing down the harvesting work of bees, which reduces productivity and suppresses the development of colonies. The application of an improved pollen collector helps to the division of flying bees, increases their flying activity and productivity in the conditions of getting bee pollen.

Keywords: bee pollen, bee colony, pollen collector.



CHARACTERISTIC OF NEW *SESAMUM INDICUM* L. CULTIVARS IN THE CONDITIONS OF PRIDNESTROVIE

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Sesamum indicum L. takes a first place among oil plants on the content of semidrying oil in seeds (48.0–63.0 %). Besides, seeds contain proteins – 16–19 %, soluble carbohydrates – 16–17 %, major mineral elements (mg/%): (Si – 351, Ca – 783–1474, Mg – 351, P – 453–694, K – 468–497) that makes respectively to (% of a day norm/person) 663, 113, 88, 68, 19. 23 micro and ultramicroelements and also 14 vitamins revealed in *Sesamum indicum* seeds. Climate aridization and use of *Sesamum indicum* seeds in food industry causes a relevance of carrying out a selection work to create a high-yielding cultivars adapted for growing in Pridnestrovie region. *Sesamum indicum* is an introduced plant species for Pridnestrovie region conditions. The considerable climatic conditions difference in Pridnestrovie, center of origin and traditional areas of *Sesamum indicum* cultivation, caused the choice of mutagenesis as a method of cultivars selection.

The goal of research – to create *Sesamum indicum* cultivars with valuable signs, adapted for cultivation in the conditions of Pridnestrovie.

Research problems – to receive mutant forms of *Sesamum indicum*, to estimate selection material on a complex of valuable signs, to allocate the most perspective forms, created as a result of individual selection from mutant plants population.

A white seeds coloring collection sample of *Sesamum indicum* from the Republican Botanical Garden (Tiraspol) was used as an initial material, belonging to *ssp. bicarpellatum* Hilt. Mutant material was received by dry seeds ⁶⁰Co irradiation in 2012. The cultivars crops scheme in the competitive test nursery 90x20 cm, plot area – 3.6 m², triple replication. Valuable signs accounting was carried out in the experience. Productivity data were processed by the dispersive analysis method.

Two cultivars of *Sesamum indicum* – Mulatka and Lebed, adapted for cultivation in the Pridnestrovie region conditions were created, using a physical mutagenesis method. Patents were taken out on them in 2018. Test of new cultivars in 2017 and 2018 showed a reliable excess on productivity in comparison with an initial sample. Productivity of Mulatka cultivar was 21.1 c/ha, Lebed – 24.5 c/ha, a control sample – 8.3 c/ha in 2017. Both cultivars are reliable exceed control in productivity at least significant difference (P≤ 0.05) of 2.6 c/ha. Besides, cultivar Lebed reliable more fruitful, than cultivar Mulatka. The productivity of studied samples was lower in 2018, but the similar regularity was observed. Productivity of cultivar Mulatka was 16.8 c/ha, Lebed – 21.4 c/ha, a control sample – 6.9 c/ha. Both cultivars Mulatka and Lebed are reliable more fruitful in comparison with a control sample at least significant difference (P≤ 0.05) of 2.97 c/ha and also cultivar Lebed is more fruitful in comparison with cultivar Mulatka.

The results demonstrate a considerably exceeding productivity of *Sesamum indicum* cultivars Mulatka and Lebed in comparison with control and their adaptation for cultivation in the conditions of Pridnestrovie.

Keywords: *Sesamum indicum* L., introduction, cultivars, physical mutagenesis, productivity.



BEE POLLEN AND BEE BREAD IN TRADITIONAL MEDICINE

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Bee pollen (BP) and bee bread (BB) (fermented bee pollen) were used in traditional medicines for wound healing and the treatment of respiratory tract infections, immune dysfunctions, gastroenteritis, gastric ulcers, and diabetes from ancient times (Helmy and El-Soud, 2012).

It should be noted that prof. Tikhonov school has been dealing with the development of medicines on the base of beekeeping products in Ukraine for many years. Prof. Brovaeskyi school (Ukraine) is dealing with the development of the technology of bee bread obtaining. Assoc. prof. Brindza school (Slovak Republic) is dealing with phytochemical and morphological studies of bee bread of different origin.

The aim of this study is to summarize publications about BP and BB and their usage in traditional medicine.

BP is rich in carbohydrates (13–55 %), B complex vitamins (thiamine, niacin, riboflavin, pyridoxine, pantothenic acid, folic acid and biotin), carotenoids, flavonoids, phenolic acids, micro- and macroelements, amino acids, lipids (1–10 %), proteins (10–40 %), sterols, terpenes, vitamins, and etc. BB additionally contains unsaturated aliphatic acids, mainly unsaturated ones (α -linolenic, linoleic, oleic, and 11, 14, 17-eicosatrienoic acids), lactic acid, alkanes (C 21-C35) (Hudz et al., 2017).

The extremely rich composition of these bee products gives a wide variety of their preventive and therapeutic effects. Up to now there were observed nutritious, antioxidant, anti-microbial, anti-mutagenic, anti-inflammatory, anti-atherosclerotic, antiallergenic, chemopreventive, hepatoprotective, hypolipidemic, hypoglycemic, and fibrinolytic effects of beekeeping products, as well as their inhibitor activity to platelet aggregation and immunomodulatory activities (Nascimento and Luz, 2018; Sig, 2019). Positive and healing effects of BP and BB (Kieliszek et al., 2018) are as follows:

- 1) BP is used in the lack of appetite, delayed development, and malnutrition in children and adults. Its extracts have antibacterial, anti-inflammatory, anti-androgenic, and anticancer properties. It has a hypoglycemic effect. When administered with antidepressants it can reduce their dose. Its long-term use of boosts mood. It can be safely used to relieve oxidative stress and inflammation of nerves;
- 2) BB reduces allergic reactions. And the opposite: bee products can cause allergic reactions, in particular, anaphylaxis (Jagdis and Sussman, 2012; Sig, 2019). It demonstrates an anti-aging and anti-anemic activity and regenerates all cells of the body. It is very helpful in the treatment and prevention of extravasations, as well as problems arising from the poor condition of the blood vessels;
- 3) Both of them (BP and BB) are food with good nutritive value and strengthen the organism in whole, especially the immune system. They have antibacterial activity and reduce the side effects of antibiotic treatment. They regulate cholesterol level in the blood and reduce total lipid content. They support the function of the hematopoietic system.

Beekeeping products have a high potential and require further research on the possibility of their use in the prevention and treatment of diseases in humans.

Keywords: bee pollen, bee bread.



WORLD TRENDS AND TECHNOLOGIES FOR PROPOLIS PRODUCTION

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Propolis production in Ukraine remains at a rather low level, and methods are mainly reduced to outdated: the placement of nets, grates above the bars of the frames or the cleaning of hive elements from the propolis stored during the beekeeping season. Under these conditions, human labor plays a significant role in the production of propolis, which greatly reduces the economic effect of the production process. The aforementioned methods in Ukraine receive from 80–100 g propolis per season from one bee family (Kryvyi et al., 2016). This necessitates the search for other methods of obtaining propolis and the study of world experience in propolis production. Its analysis will provide the basis for the development of scientific opinion in this direction. Therefore, the purpose of the work was to study the main trends and technologies of production of propolis in the world.

From the open part of the reports of various international consulting companies such as QY Research and others, the world market of consumption of propolis will increase by 3.5 % each year and by 2021 it will be approximately 2867 tons. The leading producers of this product are Brazil, China, Russia; Processing leaders are Comvita (New Zealand), Laprell's Beehive Products, Inc. (Canada), Sunyata Pon Lee (Brazil), Shaanxi Rebecca Bio-Tech Co. Ltd (China) and others.

In South American countries with a tropical climate, special devices have been widely used in the nests of honey bees. They have the short name 'CPI' ('intelligent' collector of propolis) (Lima et al., 2015; Ikeda et al., 2016). The principle of their work is to stimulate bees to cover the through holes of the device located in the hive wall with a layer of propolis, which is subsequently collected by cutting, dried and packed, and collectors are returned for further use (Breyer et al., 2016).

The countries of Europe with a moderate climate in the production of propolis use grids of artificial materials, plastic gratings placed above the nest of bees. Increasingly widespread becomes the use of nets made of such material as ethyl vinyl acetate, which retains its elasticity at low temperatures. Such propolis production technology involves freezing propolis devices for easier removal by bending them.

In Asia, the production of propolis is based on the use of metal plates with holes, which are located on the side walls of the hive. Propolis-coated plates are cleaned from the outside without interference in the bees' nest. To prevent the infiltration of pests into the hive, the hole from the outside is covered with a wooden screen. Cleaning of propolis is carried out using a metal blade.

Keywords: propolis, production, technology.

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CENTURY-OLD DENDROEXOTICS OF THE UKRAINIAN POLISSYA**Anzhela Dzyba**

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Century-old trees play an important ecological role. Their number is decreasing annually in the world due to the anthropogenic impact and unfavorable environmental conditions, resulting in a decline in biodiversity.

The purpose of the study is to hold an inventory of the century-old dendroexotics of the natural and artificial objects of the natural reserve fund of the Ukrainian Polissya, to analyze their distribution. The object of the study is century-old dendroexotics in the territory of the natural reserve fund of the Ukrainian Polissya.

Based on the conducted researches of the artificial and natural objects of nature reserves, it was discovered that the greatest diversity of dendroexotics is presented in the artificial reserve parks of the Ukrainian Polissya, in particular in the parks-monuments of landscape gardening (PMLG) of the XVIIIth-early XXth centuries. We have found the following century-old introduced tree species: *Pinus strobus* L., *Pinus ponderosa* Dougl., *Pinus rigida* Mill., *Pinus sibirica* (Rupr.) Mayr., *Pinus nigra* J.F. Arnold, *Pseudotsuga menziesii* (Mirb.) Franco, *Ginkgo biloba* L., *Larix decidua* Mill., *Larix polonica* Racib, *Larix kaempferi* (Lam.) Carr., *Thuja occidentalis* L., *Acer trautvetteri* Medw., *Acer saccharinum* L., *Acer negundo* L., *Tilia americana* L., *Fagus sylvatica* L., *Liriodendron tulipifera* L., *Fraxinus pennsylvanica* Marshall, *Fraxinus longicuspis* Siebold & Zucc., *Populus trichocarpa* Torr. et Gray., *Aesculus hippocastanum* L., *Robinia pseudoacacia* L., *Populus deltoides* Marshall, *Populus canescens* (Ait) Smith. Dendroexotics are represented by one to three specimens in 20 PMLG ('Makarevichivsky', 'Litinsky', 'Zirnensky', 'Volodymyrets', 'Horodoksky Park', 'Alexandria Park', 'Tuchinsky', 'Ushumirsky', 'Ivnitsky', 'Park named after Y. Gagarin', 'Korostyshevsky', 'Kutuzov Park', 'Vilkhovsky', 'Gorodnytsky', 'Lizogubivsky', 'Vaganitsky', 'Tupychivsky', 'Kochubeyevsky', 'Vozdvyzhensky', 'Polonsky'). One-two specimens grow in botanical monuments of nature (BMN) ('Siberian Cedar' (*Pinus sibirica*), 'Spruce' (*Pinus strobus*, *Larix decidua*), 'Tulip Tree' (*Liriodendron tulipifera*), 'Century-old chestnut', 'Horse-chestnut' (*Aesculus hippocastanum*), in two complex nature monuments 'Triputnyansky park' (*Aesculus hippocastanum*), 'Vladimiretsky park' (*Robinia pseudoacacia*), in landscape reserve 'Sirche' (*Thuja occidentalis*). 4–6 specimens and an array of dendroexotics were discovered in the BMN 'Juzefinska Dacha' *Pinus strobus*, *Pinus nigra*, *Robinia pseudoacacia*, in botanical reserve 'Gubine' *Larix decidua*, *Larix polonica* (array), *Pinus strobus*, in arboretum 'Pilyava' *Larix decidua* (array), *Fagus sylvatica*. The oldest *Larix decidua* (190 years) (array) grows in Zhytomyr oblast in the BMN 'Modrina'.

In the nature reserves of the Ukrainian Polissya, there are 11 species of the century-old dendroexotics of the *Pinophyta* division and 13 species of the *Magnoliophyta* division. They are mostly represented in PMLG, where they grow by 2–6 specimens. *Pinus strobus*, *Larix decidua*, *Robinia pseudoacacia*, *Aesculus hippocastanum* grow in three to five localities. The oldest plantations are from *Larix decidua*.

Keywords: century-old, the Ukrainian Polissya, dendroexotics.

Acknowledgments

The representation of century-old dendroexotics in the Ukrainian Polissya and in protected areas is presented.

**BIOLOGICAL ACTIVITY OF EXTRACTS FROM SOME SPECIES OF CONIFEROUS PLANTS****Dina Elisovetcaia¹, Raisa Ivanova¹, Diana Gladei¹, Jana Simkova², Ján Brindza²**¹Institute of Genetics, Physiology and Plant Protection, Chisinau, Republic of Moldova;
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The development and use of biological preparations based on plant secondary metabolites is an important trend in modern organic farming. The aim of this study was to determine the biological activity of extracts and essential oils from some species of Coniferous plants, namely *Juniperus sabina* L. and *Pinus sylvestris* L., growing in Republic of Moldova (RM) and in Slovak Republic – Nitra (SN) and Pianiny mountains (PM).

The antioxidant activity of ethanolic extracts of Coniferous was determined by two procedures with appreciation of their radical scavenging capacities against DPPH and peroxy free radicals. The trolox and gallic acid serve as standard antioxidant substances. The antioxidant activity of plant extracts was evaluated in equivalent of both standard substances and by indexes IC₅₀ (the extract concentration that scavenged 50 % of free radicals). According to all determined indexes the antioxidant activity of tested extracts from Coniferous plants was qualified in followed order: *J. sabina* SN > *J. sabina* PM > *J. sabina* RM > *P. sylvestris* RM ≥ *P. sylvestris* SN. It should be mention that the scavenging of the same amount of peroxy radicals was carried out with the lower concentrations of alcoholic extracts than to inhibit of DPPH radicals. Therefore, the indexes IC₅₀ (mg per g of dry residue) of extracts against DPPH and peroxy free radicals were equal, respectively: 1.64±0.01 and 0.13±0.01 for *J. sabina* SN; 1.93±0.01 and 0.15±0.04 for *J. sabina* PM; 2.60±0.17 and 0.16±0.02 for *J. sabina* RM; 6.68±0.64 and 0.41±0.03 for *P. sylvestris* RM; 7.28±0.55 and 0.51±0.04 for *P. sylvestris* SN.

Moreover, the biopesticidal (insecticidal, ovicidal, antifeedant, repellent and deterrent) properties of Coniferous plant extracts and oils were studied. As a result of biological activity testing it was established that both ethanolic extracts and essential oil *J. sabina* possessed high efficiency against Colorado Potato beetle *Leptinotarsa decemlineata* Say and wax moth *Galleria mellonella* L. Mortality of imago and larvae consisted in average 6.7–53.3 and 66.7–100 % respectively, ovicidal activity was 100 %, and antifeedant effect persisted at the level of 1–3 points for imago and 1 point for larvae. It was established that the treatment of feed and insects with the essential oils of *P. sylvestris* needles resulted in the death of only 6.7–13.3 % of the wax moth larvae. There was also noted a decrease at the rate of formed pupae and emergence imagoes by 20 % compared with the control. It was determined that essential oils had a deterrent effect on egg-laying of the wax moth.

Extracts from *J. sabina* exhibited a selective effect on various groups of insects and, therefore, allow preserving the biodiversity of agrocoenosis, which is favorable for entomophagous. The results will serve as a basis for the selection of the most effective plant extracts for further their use to protect plants from pests, as well as to increase the resistance of plants to diseases and other adverse environmental factors.

Keywords: Coniferous plant, extract, essential oil, antioxidant activity, biopesticide property.

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OVERVIEW OF TRADITIONAL ECOLOGICAL KNOWLEDGE AND PERSPECTIVES OF ITS APPLICATIONS IN SLOVAKIA

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The current protection trends and the overall use of ecosystems are based on scientific research and often marginalize observations and experiences of local residents and knowledge passed down orally from generation to generation (oral history). The traditional ecological knowledge (TEK) withstood the test of time and is independent of whether it has or has not been scientifically explained (although some information has been later confirmed). These findings support, directly or indirectly, the intentions of the CBD, National Biodiversity Strategy in Slovakia and the platform IPBES.

The review paper summarizes and systemizes the existing information on TEK and also includes results of fieldworks by the presentation of case studies. So far, our international cooperation in the area of TEK has been focused mainly on the V4 countries (also Ukraine, Romania, Austria, and Germany). The research on the TEK is prominent especially in Eastern Europe as the population in Western Europe failed to keep track of TEK because of the heavy industrialization (intensive technocratic agriculture etc.). The basic attributes of TEK are originality (they are 'indigenous'), sustainability (often used for hundreds of years) and cultural heritage. The TEK is characterized by high inter-disciplinarity as it uses the knowledge and methods of ecology, anthropology, history, ethnology, ecology, nature conservation, etc. The practical use of the TEK is applied mainly in the area of natural resources utilization and in the preservation of local communities. However, it is also important to verify the TEK because the environmental conditions and the level of knowledge (local and scientific) are changing over time. The basic methods of obtaining information on traditional environmental knowledge are observation and controlled interview. Local ecological knowledge is also important in today's changing conditions, e.g. climate change. Local people have their own seasonal observations (phenomena, their course, phenology, population dynamics of different species of plants and animals, etc.) and knowledge on biological invasions (new species of plants and animals in the area), water regime (floods, water level changes, etc.), behavior of animals (e.g. when predicting certain events) etc. Since 2016, the Department of Environmental Management (and its predecessors) at the Faculty of European Studies and Regional Development of SUA in Nitra in cooperation with other institutes have been organizing international seminars entitled Traditional Ecological Knowledge (TEK 2016-2018). These seminars presented some of the first works focused on the theory of TEK in Slovakia and its use (in agriculture, provisional and cultural ecosystem services and disservices of natural and semi-natural ecosystems, healing, nutrition, conservation of biodiversity, meteorological phenomena, mitigation of climate change impacts, etc.).

Keywords: biodiversity, ecosystem services, Slovak Republic, traditional ecological knowledge.

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GENETIC RESOURCES OF FRUIT TREES AND THEIR USE IN THE AGROFORESTRY

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The diversity of cultivated plants has dramatically decreased due to the industrialization of agriculture over the last 100 years. It is very important to preserve the old cultivars for the next generation. It is a goal of the Gene Bank of the Slovak Republic.

The Gene Bank is a specific technical institution for medium-term and long-term storage of the genotypes in the vital state in *ex situ*, *in vitro* and field collections. The Gene Bank, situated in Piešťany, stores 18 832 seed accessions at the active collection and 3 944 accessions at the base collection. The field fruit trees collection was planted in years 2005–2007 and is being revised continuously. Each genotype is represented by three or two trees. It means more than 740 fruit trees can be found in the orchard in Piešťany at this time. These fruit trees genetic resources are available for use by other researches for their scientific projects and also for saving and sustainable use of plant genetic resources in systems on-farm.

Field fruit trees collection in the Gene Bank of the Slovak Republic consists of 106 peaches varieties and cultivars (*Prunus persica* (L.) Batsch), 42 cherries (*Prunus avium* (L.) L.) and 117 apricots genotypes (*Prunus armeniaca* L.).

Agroforestry is an integrated land-use system that combines elements of agriculture (agro) and trees (forestry) in a sustainable production system. It promotes functional bio-diverse systems that balance productivity with environmental enhancement and protection. Agroforestry systems are classified as silvoarable (trees and crops) or silvopastoral (trees and animals). Systems can combine the production of a wide range of products including food, fuel, timber, forage, medicinal products, recreation, and ecological services. Old fruit trees genotypes are suitable for growing in agroforestry systems. There are planted on seedling rootstocks in wider row spacing distances and are deliberately used on the same land-management units as agricultural crops or animals, in some form of spatial arrangement or temporal sequence. Such fruit trees with a longer lifetime are an important part of the landscape.

We consider the agroforestry as one of the best tools available to mitigate and adapt to climate change. The Gene Bank of Slovak Republic has participated in a few projects focused on saving of fruit trees genetic resources and their exploitation in the agroforestry. Bio-economic models predict that silvoarable systems are more profitable than the comparable forestry or arable systems, because of the increased land productivity.

Keywords: agroforestry, agroforestry systems, genetic resources, gene bank, fruit trees, orchard, old cultivar.



ACTIVITIES OF THE CENTRE FOR ORGANIC PRODUCTION IN SELENČA

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The Centre for Organic Production in Selenča is a voluntary, non-governmental and non-profit association. It aims to improve and develop organic agricultural production, protect the interests of producers, processors, traders, as well as consumers of organic products and expand the production and consumption.

The Centre's vision is to create a cluster as a regionally recognized innovation cluster that has a strong impact on stimulating the development of the organic farming sector, in accordance with the recent trends and examples of good practice. The mission of the Centre is to improve the business of members involved in various activities in the organic production sector, as well as to improve working conditions in this sector, to provide a quality product that complies with modern world standards for healthy food, ecology and environmental protection.

Main trends of the Centre

1. Development of the Centre by expanding its membership and developing new services
2. Creating business networks and developing multiple value chains
3. Human resources development
4. Promotion of the Centre and its members in the region
5. Developing active international cooperation
6. Development of innovations and their implementation.

Since the establishment of the Centre in 2007, many activities have been realised which, with the support of the founders, members and relevant institutions at home and abroad, have produced the following results:

Established premises of the Centre – with the help of the "Slovan Progres" Centre, Selenča is provided with the premises of an area of 450 m²

Establishment of the training centre – the training program provides members with various specialized courses, lecture cycles and knowledge transfer from research workplaces.

Organized Farm Incubator – members of the Centre have set up an active farm incubator. In the incubator was created a possibility for practical training of members by applying cultivation technologies from different types of plants with a link to traditional and modern technologies.

Formed demo-fields – The Centre for Organic Production, with the support of the International Food and Agriculture Organization of the United Nations, has established demo-fields at the Secondary Agricultural School in Báč, which is a member of this Centre. Demonstration fields consist of live textbooks for students and farmers.

Development of the Centre e-portal – the created portal provides an active transfer of information for potential and existing organic farmers as a unique concept of the advisory services system in organic farming and 'training centres', which provide regular consultations in the development of educational materials and databases.

Formed partnerships – the Centre has established active cooperation with domestic and foreign institutions.

Organic Production Forums – the Centre for Organic Production in Selenča has been organizing regular Organic Production Forums for 13 years. It is traditionally taken place each year in September and includes a large number of manufacturers, experts and representatives of state and scientific institutions from the country and abroad.

Keywords: Centre for Organic Production, activities, organic products, education.



ADAPTIVE PROPERTIES OF BEANS CULTIVARS IN THE CONDITIONS OF SOUTH URALS AND THEIR INTERACTION WITH ENDOPHYTIC BACTERIA

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The purpose of this work was an analysis of the productivity, environmental plasticity and resistance to diseases of different cultivars of beans (*Phaseolus vulgaris* L.) in a wide range of climatic conditions and their response to inoculation by endophytic bacteria. The objects were the local cultivars Ufimskaya and Zolotistaya and a new cultivar Elsa of French selection (sample No. 14693 from the VIR collection). Endophytic bacteria strains are stored in the collection of Bashkir Research Institute of Agriculture. Field small-scale experiments were carried in the period of 2003-2018 years at the hydrothermal coefficients 0.2–1.6.

The seed productivity and yield of all bean varieties were close: 7.3–9.3 g/plant and 19.7–22.0 g/m². But the coefficients of variation of yield for the Ufimskaya and the Zolotistaya cultivars were 24 and 29 %, for the Elsa cultivar – 57 %. In favorable climatic conditions, the Elsa cultivar gave the high seed productivity 26.7 g/plant, but under severe drought it was 0.6 g/plant, which is 3 times lower than that of local cultivars. Correlation was low between the seed productivity of the Zolotistaya and the Ufimskaya cultivars plants and the sum of active temperatures ($r = 0.46$, $r = 0.59$). The Elsa cultivar was more dependent from favourable conditions: the correlation coefficient between these indicators was high (0.84). Between the duration of the period above 15 °C and seed productivity, the correlation coefficients for the Ufimskaya and the Zolotoistaya cultivars were low (0.20 and 0.40), and for the Elsa cultivar 0.69. Attitudes toward biotic stress were found in the studied cultivars in the 2015 season, when an increased level of leaf lesions was observed. The Elsa cultivar was resistant to them. The Zolotoistaya and Ufimskaya cultivars were moderately susceptible to leaf diseases at the beginning of the growing season. But at the end of the growing season, healthy leaves grew on plants of the Ufimskaya cultivar, and the Zolotoistaya cultivar plants had 90 % damaged leaves. In relation to root rot, the Ufimskaya cultivar was more resistant than the Zolotoistaya and Elsa cultivars.

The lack of adaptive traits of plants can be complimented by inoculation with endophytic bacteria. On a high infectious background in 2015, inoculation of the Ufimskaya and the Zolotistaya cultivars by the composition of endophytic *Bacillus subtilis* SG12 and *Rhizobium leguminosarum* SG13 promoted the seed productivity in 1.5–2.0 times compared with control, decreasing diseases. In 2018, without biotic stress, but in conditions of abiotic stress, the inoculation of Zolotistaya cultivar with endophytic *B. subtilis* 26D contributed to an increase of seeds yield on 39 % compared with control, and inoculation of Ufimskaya cultivar with endophytic *B. subtilis* 10-4 promoted seed weight by 31 % than control. Seed productivity of the resistant to diseases Elsa cultivar, in favourable abiotic conditions of 2015, was raised on 17 % compared with control under inoculation by suitable *R. leguminosarum* 2630 strain.

Keywords: adaptive properties, *Phaseolus vulgaris*, local and new cultivars, biotic and abiotic stress, endophytic bacteria.

ANTI-ANEMIC PROPERTIES OF MEDICINAL PLANTS

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Anemia is a disease that is spread throughout the world and occurs as a result of lowering erythrocytes and hemoglobin in the blood. The causes of anemia are different. This may be a lack of trace elements or a deficiency of vitamins B₆, B₉, B₁₂ (folic acid deficiency anemia), and in the case of acute bleeding, post-hemorrhagic anemia. Hemolytic anemia develops in the destruction of erythrocytes, and if defective hematopoiesis is hypoplastic anemia. The listed forms of anemia are rare, which can not be said about iron deficiency anemia. In this form of anemia in Europe, 40 % of women and 15 % of men are ill. The daily dose of elemental iron should not exceed 100 mg and is divided into 3–4 meals before meals, but it does not always have a positive effect, so the use of medicinal plants with anti-anemic properties is currently a very topical problem. Why medicinal plants? The plant is a biofactory that produces many biologically active compounds of different orientations. Plants are used as reductive therapy, which restores the activity of enzymes, dietary therapy, which introduces into the body insufficient products of intermediate metabolism and detoxification.

In view of this, the purpose of this work was to study the effect of water – salt extracts of medicinal plants on the osmotic resistance of erythrocytes. The following plants were used as experimental samples: *Hypericum perforatum* L.; *Trifolium pratense* L.; *Taraxacum officinale* Wigg; *Plantago major* L.; *Cichorium intybus* L.

Osmotic resistance of erythrocytes, which was received from the blood of donors, was determined by the level of their hemolysis. For these erythrocytes were treated with 0.1 % water-salt extracts from plants. To obtain aqueous-salt extractors, a solution of 0.15 mol/L of NaCl was used. The resistance of erythrocytes was determined by the percentage of hemolysis in buffered isotonic solutions of sodium chloride of different concentration from 0.1 to 1.0 % after the effect on them of water-salt extracts of experimental plants. The state of osmotic resistance of erythrocytes depends on membrane permeability, the level of free radical processes and the state of antioxidant systems. Controls were erythrocytes that were not treated with extracts of experimental plants.

The obtained results showed that experimental plants increased the osmotherapy resistance of erythrocytes, but differently. So *Hypericum perforatum*, depending on the growth site, reduced the erythrocyte hemolysis from 10 to 20 %, *Trifolium pratense* – decreased by 10–15 %, *Taraxacum officinale* – by 30–35 %, *Plantago major* – by 10–20 %, *Cichorium intybus* – 10–30 %. Although, according to folk medicine, only *Hypericum perforatum*, *Trifolium pratense*, and *Plantago major* are influenced by hemostasis from our experimental plants. Previous studies of *Rosa cinnamomea* L. and *Crataegus oxyacantha* showed that these plants have high anti-anemic properties.

Thus, it is necessary to expand the range of plant studies that may have potential anti-anemic properties, taking into account their place of growth and individual sensitivity to them.

Keywords: erythrocytes, medicinal plants, osmotic resistance.



ENDOECOLOGICAL STATE OF THE CHILD HEALTH

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Interaction of environment and human becomes more actual question every year. Scientific and technical progress has led to the destruction of ecological equilibrium with negative effects on human health. The problem of interaction of environment and human can be presented by the following scheme: E (environment) – O (organism) – D (disease). D (disease) determines by the interaction of E (environment) with O (organism).

First, in the 1999 Yu.P. Gichev offered to consider human health as an important component of ecological monitoring and basic bioindicator of ecological risk. Different parameters of children health state used for evaluation of the effect of ecological condition in the present territory. This caused by anatomical and physiological properties of the child organism, which is more sensitive to the negative effect of the environment than an adult. Adaptive mechanisms of child organism exhausted faster than an adult that led to the overvoltage, also, occur significant changings of functional activity of organs and systems.

Nowadays children health becomes quite full ecologically depending, particularly actual question is about the development of screening methods of determination of children health level. In this work used method (endoecological investigation) of determination of the functional state of basic organs and systems of children body concerning the functional equilibrium. During study was measured bio galvanic current, which arising in orgasm at the work of two electrodes: zinc – silver (copper) and biologically active zones. Equipment was microammeter of constant current. In this case, this methodology used the individual ability of an organism to generate bio galvanic current in both systems of internal and external use, considering obtained effects and biophysical phenomena and based on the regulatory framework of system energetic equilibrium (vegetative homeostasis). Today methods don't allow to test little changing of functional state on the level of vegetative homeostasis as it possible with used in this study methods. In this context bio galvanic diagnostic allows realizing constant system control above processes of stabilization, generation or degradation.

Numerous endoecological investigations of children from different regions of Kyiv city, Kyiv region that carried out in Institute of Human Ecology during some years confirmed that in the dynamic of determination of functional state the children healthy is a natural bioindicator of environment where children are living. On the other hands, this diagnostic allows tracking the effect of any factors on the organism of human, whether it be water, foodstuffs, medicals, biologically active natural compounds, etc.

Daily effect of negative ecological factors on the functional condition of children organism requires constant endoecological prevention. Very important role play phytomedicines, due to the deep impact on all biochemical and physiological processes of children organism. Biologically active compounds of medicinal herbs, vegetables, fruits are modulators of the humoral system of the organism. Natural antioxidants and adaptogens able to protect the cells from the damaging effect of free radicals.

Methods of endoecological diagnostic and prevention used and can be widely used in childcare facilities of Kyiv city and region within the program 'Ecology, children, future'.

Keywords: children health, environment, endoecological investigation.



COMPARISON OF ANTIOXIDATIVE PROPERTIES OF FRUIT POMACE FROM DIFFERENT CULTIVARS OF HONEYSUCKLE BERRY

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According to the current studies, honeysuckle berry fruit show antioxidant, anti-inflammatory, anti-cancer properties, as well as cardio and neuroprotective. Researchers have analyzed a vast content of iridoids and phenolic compounds in the fruit. Additionally, numerous cultivars of honeysuckle berry have been identified. Many researches depict that existing cultivars differ in the content of anthocyanins, flavonoids, phenolic acids. The compounds being present in the fruit are able to neutralize reactive oxygen species, which is mostly associated with the presence of polyphenols. Therefore, it becomes crucial to determine the cultivars with the greatest content of bioactive compounds and best health properties. An important aspect of the research is focusing on the side product being formed during juice pressing-pomace. They are often considered as a waste product, while they might be a source of vital bioactive substances. An analysis of the compounds contained in honeysuckle berry pomace could potentially correspond to minimizing the waste product and thus decreasing the production costs.

The aim of the research was to determine the antioxidant activity of analyzed fruit pomace its being important in terms of science and application and to compare the impact of different extraction conditions.

In this study, the pomace of 5 honeysuckle berry cultivars were analyzed: Jugana, Honey Bee, Indigo Gem, Wojtek Docz Velikana. The antioxidant activity was measured using ABTS, FRAP, DPPH methods. The extracts for the analysis were prepared using 8 different conditions: 25 % methanol + 1ml/L HCl, 50 % methanol + 1ml/L HCl, 80 % methanol + 1ml/L HCl, 100 % methanol + 1ml/L HCl, H₂O 100 °C, H₂O 40 °C, 25 % methanol, 50 % methanol.

Among the analyzed cultivars, the highest ABTS value showed Wojtek, while the lowest activity indicated Docz Velikana (1.63 mM Tx/100 g). In terms of FRAP the highest result was measured in cultivar Jugana (12.03 mM Tx/100 g), and the lowest in Docz Velikana (1.45 mM Tx/100 g). The last analysis- DPPH, showed the highest activity of Jugana (4.65 mM Tx/100 g), and the lowest of Docz Velikana (0.31 mM Tx/100 g). In terms of extraction method, more concentrated methanol (50 % and more) provided in more effective extraction.

It can be concluded that fruit pomace shows antioxidant activity and the differences between various varieties can be observed. Pomace is, therefore, a promising source of bioactive compounds and do not have to be considered as a waste product.

Keywords: honeysuckle berry, cultivars, antioxidant, fruit pomace.

**POLLEN MORPHOLOGY OF SOME SPECIES OF THE GENUS *AMELANCHIER* MEDIK.****Olga Grygorieva¹, Ivan Gurnenko¹, Svitlana Klymenko¹, Svetlana Motyleva²**¹M.M. Gryshko National Botanical Garden of the National Academy of Sciences of Ukraine, Kyiv, Ukraine; E-mail.: olgrygorieva@gmail.com²Federal State Budgetary Scientific Institution All-Russian Horticultural Institute for Breeding, Agrotechnology and Nursery, Moscow, Russian Federation

Pollen grain structure is one of the diagnostic taxonomic and phylogenetic parameters. Study of morphology and morphometry of pollen grains of *Amelanchier* spp. allows found new additional diagnostic parameters of species.

The aim of this study was to compare the morphological parameters of pollen grains of the five species of *Amelanchier* spp.

Pollen grains studied on the species collected in Forest-Steppe of Ukraine in M.M. Gryshko National Botanical Garden of NAS of Ukraine (NBG). The following species were analyzed: *Amelanchier alnifolia* (Nutt.) Nutt. ex M. Roem., *Amelanchier arborea* (F.Michx.) Fernald, *Amelanchier canadensis* (L.) Medik., *Amelanchier lamarckii* F.G. Schroed., *Amelanchier spicata* (Lam.) K. Koch. An investigation carried out at the laboratory of Department of Tropical and Subtropical plants of NBG using an electron microscope Carl Zeiss LS 15. The measurement of morphometric parameters was carried out on 50 pollen grains from each species using the AxioVision Rel. 4.8.2.0 program. The measurements were made in micrometer (µm). The length of a polar axis (P) and the equatorial diameter (E) of grain, P/E ratio were measured and their variation was compared among studied species.

SEM investigations showed that the pollen grains species of *Amelanchier* are oblong-spheroidal, 3rd furrow is meridional, in outline from the pole are three furrow - the furrows are long, narrow, smooth. The surface sculpture and shape index of the species vary. The average length of the polar axis varied from 13.03 to 21.37 µm and the width of the equatorial axis was in the range from 6.55 to 11.96 µm. Shape index (P/E) of tested species varied from 1.54 to 2.33. The most average length of pollen was *Amelanchier spicata* (20.17 µm), *Amelanchier canadensis* (19.46 µm), the least length was *Amelanchier arborea* (13.69 µm). The most average width pollen y *Amelanchier lamarckii* (10.59 µm), *Amelanchier canadensis* (10.11 µm), and the least width was *Amelanchier arborea* (7.15 µm).

Pollen grains of *Amelanchier alnifolia* among other species the longest from the poles, slightly pointed. Ultra-sculpture of exine is finely trickled, often perforated on all surface. Pollen grains of *Amelanchier arborea* long from poles, rounded. Ultra-sculpture of exine is wide streaming and less perforated then *Amelanchier alnifolia*. Ultra-sculpture of *Amelanchier canadensis* exine is pronounced streaky, dense, relief, perforation not often, close to poles. Pollen grains of *Amelanchier lamarckii* and *Amelanchier spicata* had the most equatorial diameter and more rounded shape than other species. *Amelanchier lamarckii* ultra-sculpture width streaky, sometimes intermittent, perforated on all surface. Ultra-sculpture of exine of *Amelanchier spicata* not perforated, intermittently finely trickle.

Studies have established characteristic differences in the morphometric and microsculptural features of pollen for each of the studied species of *Amelanchier* spp.

Keywords: *Amelanchier* spp., pollen, SEM, morphology.

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EFFECT OF SEED INOCULATION WITH NODULE BACTERIA ON SOYBEAN YIELD

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Soybean is quite demanding on the soil, its fertility, moisture supply and reaction of the soil solution. It is known that the formation of the harvest of any cultivated crop, including soybeans, occurs already from the initial phases of their growth and development and depends on many environmental factors during its growth.

The aim of our work that makes it possible to evaluate the effectiveness of the application of various agricultural methods for improving the conditions for growing crops was their impact on the yield and quality of the final plant products. The average yield when using biological products based on nitrogen-fixing microorganisms is 2.11 t/ha. Field experiments were carried out according to the generally accepted method of a field experiment in crop production (Dosphehov, 1985), accompanied by observations, definitions, accounting, and analysis. The repetition of the experience of four times, the placement of areas randomized. The sown area was 25 m², the registration area – 10 m². The research results indicate that the highest yield was owned by the variant using the adapted *Bradyrhizobium japonicum* isolate LG 5 since the yield increase was 29.2 % relative to the control.

The yield of soybean seed varieties Moravia for the actions of the culture fluids of the studied soybean nodule bacteria was analyzed. It is known that the use of microbial preparations contributes to an increase in seed productivity since for such a legume culture as soybean it is very important to have an adequate and optimal level of nitrogen supply. Only under the condition of a highly efficient partnership of macro- and microsymbiont and as a result of the enhancement of a number of physiological and biochemical processes, growth processes and the formation of seed yield are activated.

As a result of the analysis of the conducted research, it was established that the yield of soybean was formed depending on weather conditions and the use of culture liquids of nodule bacteria. It was revealed that over the years of field studies of isolates of *B. japonicum* LG 2 and LG 5, depending on the type of experience, the yield was within 2.56–2.97 t/ha. The results of the research indicate that the treatment of the culture fluid of the new isolates contributed to the increase in yield. seeds of soybean plant Moravia and the yield increase was 22.4–29.2 % relative to the control.

The use of the culture fluid of the isolate *B. japonicum* LG 5 contributed to an increase in yield by 4.4 % compared with the variant with the use of the drug Rizoaktiv. In the variant with the use of *B. japonicum* LG 2 isolate, the harvest was at a level using the presowing bacterization of soybean seeds with Rizoaktiv preparation.

Thus, our experimental data on soybean yields are consistent with our research on the passage of biological processes in plants and soil and indicate that the increase in productivity of soybean plants is, on the one hand, a consequence of the functioning of the *Bradyrhizobium japonicum* – *Glycine max* (L.) Merrill symbiotic system. Specifically, such features as a significant nodulation ability, high nitrogenase activity, virulence and competitiveness of nodule bacteria isolated from the soil and presented in our research, influence the course of the main physiological processes in soybean plants, giving an opportunity to get a sustainable and organic soybean harvest.

Keywords: soybean, yield, *Bradyrhizobium japonicum*, symbiotic system, nitrogenase activity.



EVALUATION OF *CAMELINA SATIVA* (L.) CRANTZ GENOTYPES VARIABILITY IN MORPHOLOGICAL AND ECONOMIC CHARACTERS AS PROMISING BREEDING MATERIALS

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Camelina sativa (L.) Crantz is a short-season crop adapted to the cool temperate regions of Europe, Asia, and North America. *Camelina* has many traits that make it an ideal candidate for oil production, crop rotation schemes or a crop for marginal lands. Although no original Slovak cultivars are known to be preserved, *Camelina* attracts the interest of Slovak agronomists and biofuel producers as potential feedstock for the production of bio-components to fuels which can contribute to achieving the increase of GHG savings.

The aim of this study was to determine the genotypes variability of some morphological and economic characters of *Camelina sativa*. The results obtained will help us to select the most promising samples for further breeding work. The objects under studying are *Camelina* plants and *Camelina* field trials. *Camelina* spring (15 varieties) and winter (2 varieties) were grown at National Agricultural and Food centre, Research and Breeding Station at Víglaš – Pstruša, Slovakia (48°33'20"N 19°17'41"W). The study was conducted for one growing season in the year 2019, in Slovak cultivation conditions. Two winter genotypes originating from Spain did not survive the winter of 2018-2019 and completely froze. In the study only one plant used per genotype (morphological characters). The following measurements were taken: Plant – leaf rosette form (5 genotypes spread form, 6 genotypes semi spread form, 4 genotypes erect form). Plant-stem color (2 genotypes light green, 4 genotypes green, 1 genotype dark green, 8 genotypes light violet). Bottom leaf – color (3 genotypes light green, 10 genotypes green, 2 genotypes dark green,). Bottom leaf –margins serration (1 genotype without margins serration, 2 genotypes little margins serration, 9 genotypes middle margins serration, 3 genotypes big margins serration). Bottom leaf – the length: width ratio (6 genotypes narrow, 6 genotypes middle, 3 genotypes wide). Inflorescence density (0 genotypes sparse, 8 genotypes intermediate, 7 genotypes dense). Flower –color of crown crisps (2 genotypes light yellow, 13 genotypes yellow). Silique-position (7 genotypes middle, 8 genotypes horizontal. The following measurements were taken from plots (economic characters): Lodging resistance (all 15 genotypes resistant to lodging). Height of plants (lower genotype 70 cm, highest genotype 90 cm). Beginning of flowering (earliest genotype 20.5, latest genotype 27.5). Yield of seeds (least yield genotype 0.3 t.ha⁻¹, yelder genotype 0.8 t.ha⁻¹). Oil content (only two genotypes, year 2018, from 35.5–37.9 %). In 2019, we realized 24 combination crosses between individual genotypes, with the successful acquisition of hybrid seeds. Selected genotypes (varieties) were tested for yield at different fertilization levels.

Keywords: *Camelina sativa*, characters, breeding material

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HISTORY OF THE CREATION OF ORCHARDS IN THE LONG-STANDING ESTATES OF KHARKIV REGION (ON THE EXAMPLE OF KRASNOKUTSKY PARK)

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'Osnovyansky acclimatization garden of Karazin' played an important role in the center of the introduction of tree plants in the territory of Left-Bank Ukraine. Today it is Krasnokutsky Park, a monument of landscape art of national importance. During the existence of which 56 species of tree plants, among them – and the fruit was first introduced into the Left Bank Forest-Steppe.

The purpose of the work is to study the composition of the park's dendroflora, including the first-introduced fruit trees and shrubs in Ukraine.

The object of study is the denroflora of Krasnokutsky Park, located in the Kharkiv region. Its area is 13.6 hectares. It was founded in 1809 by Ivan Nazarovich Karazin (1780–1836), the well-known botanist.

The composition of the species and cultivars of the park was established by the method of route surveys. Plant names are listed on The Plant List.

Ivan Nazarovich Karazin, traveling around Europe, America, studied the experience of introduction and gardening, sought to enrich the flora of Ukraine with new valuable, ornamental and fruit trees. According to the data of 1833, he collected a collection of 202 species, varieties of trees and shrubs. In addition, a collective orchard, in which there were about 200 varieties of apples, more than 200 cultivars of pears, 100 cultivars of plums, 70 – cherries, 20 – grapes were created. Father's work was subsequently continued by his son, Ivan Ivanovich Karazin (1834–1903). At the time of I. I. Karazin, the number of species and cultivars of ornamental woody plants reached 540 in 1899, and the number of fruit varieties almost doubled, as compared with 1833. In the records led by I. I. Karazin, 400 cultivars of apple trees, 360 cultivars of pears, 110 cultivars of plums, 65 cultivars of cherries and cherries, 18 cultivars of apricot, five cultivars of peaches were registered. Thanks to the hard and long work of Karazins, the flora of Ukraine was enriched with ornamental and fruit trees.

In the park, centuries-old trees are preserved. Among the centuries-old preserved and plants with fruits and nuts, which are used in foods, it is *Cornus mas* L. (Karazinsky), *Corylus colurna* L., *Prunus padus* L., fruits and flowers of some species are used in medicine. For the first time in Ukraine, the Karazins introduced four species of *Crataegus* Tourn. ex L. (*C. crus-galli* L., *C. flava* Sol., *C. orientalis* Pall. ex M. Bi., *C. viridis* L.), *Morus nigra* L., *Cornus mas*, *Ziziphus jujuba* Mill.

Generally, in the park representatives with the fruits used for food of the following genera: *Amelanchier* Medik., *Aronia* Medik., *Chaenomeles* Lindl., *Crataegus* Tourn. ex L., *Corylus* L., *Hippophae* L., *Lonicera* L., *Morus* L., *Prinsepia* Royle, *Ribes* L., *Rubus* L., *Viburnum* L., et al. were grown.

Thanks to these scientists and gardeners, the horticultural culture was encouraged, new species and varieties of ornamental and fruit plants, many of which are still relevant and loved today, have been distributed.

Keywords: Krasnokutsky park, introduction, fruit crops.

Acknowledgments

Studies were conducted in 1997 (Yu.O. Klymenko), 2016 and 2018 (A.V. Hryhorenko and Yu.O. Klymenko).

**CHEMICAL COMPOSITION OF *SATUREJA MONTANA* L. CULTIVATED IN UKRAINE****Nataliia Hudz¹, Marietta Białoń², Liudmyla Svydenko³, Piotr Paweł Wieczorek²**¹Danylo Halytsky Lviv National Medical University, Lviv, Ukraine;

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Satureja montana L., commonly known as winter savory or mountain savory, belongs to the Lamiaceae family. It is a perennial semishrub (20–30 cm) that inhabits arid, sunny, and rocky regions. The purpose of our study was to determine volatile compounds of *S. montana* aerial parts cultivated in Plodove (Ukraine).

The volatile compounds of *S. montana* aerial parts were identified by comparing the mass spectra data with spectrometer database of the NIST 11 Library and by comparison of their retention index calculated against n-alkanes (C₉–C₂₀). Each chromatographic analysis was repeated three times. The average value of the relative composition of the essential oil percentage was calculated from the peak areas. The Hewlett Packard HP 6890 series GC system chromatograph was used for the study, which was coupled with the Hewlett Packard 5973 mass selective detector (Hewlett Packard, Waldbronn, Germany). The chromatograph was equipped with the non-polar, high-temperature ZB-5HT (5 % diphenyl, 95 % dimethylpolysiloxane) capillary column; length, 30 m; inner diameter, 0.32 mm; film thickness, 0.25 μm (Phenomenex Inc., Torrance, CA, USA). The gas chromatograph was equipped with a split injector; the split ratio was 20:1 and 1 μm of a sample was introduced. Helium served as the carrier gas, and its flow rate was 2 mL/min. Analyses were performed at a temperature of 40–280 °C and the heating rate was 10°C/min. Injector temperature was 250 °C.

According to the published data, essential oil of *S. montana* consists mainly of carvacrol (0.1–53.35 %), *p*-cymene (0.66–41.4 %), thymol (0.15–46.0 %), linalool (0.1–50.42 %), and other monoterpenoids, as well as sesquiterpenes and diterpenes. Based on an analysis of the chemical composition of the *S. montana* essential oil, currently, some chemotypes are identified. Among them are chemotype of thymol and carvacrol, chemotype of linalool, *p*-cymene, and α-terpineol, chemotype of linalool, intermediate chemotype of *p*-cymene/linalool, chemotype of *p*-cymene, thymol and carvacrol, chemotype of myrcene and viridiflorol.

Based on the experimental studies conducted, the authors established the presence of a special chemotype of *S. montana* grown on experimental plots in the Kherson region. *p*-Thymol was dominated (about 81.79 %) in its essential oil. In general, 34 compounds were identified. *p*-Thymol has not been stated earlier in the available scientific publications as the dominant component of the *S. montana* essential oil. Among minor components was linalool 2.09 %, *o*-cymene 1.26 %, *cis*-β-terpineol 1.21 %, terprinen-4-ol 1.07 %, thymol 0.65 %, carvacrol 0.05 %. According to literature data, essential oils in which such aromatic substances as carvacrol, eugenol or thymol dominate have a pronounced antimicrobial action. Hajdari et al. (2016) stated the absence of carvacrol in the myrcene and viridiflorol chemotype and linalool chemotype. These chemotypes contained also minor amounts of thymol (0.15–0.79 %).

As a result of the performed studies, the new chemotype of *S. montana* was identified.

Keywords: *Satureja montana*, essential oil, *p*-thymol.



DETERMINATION OF THE TOTAL PHENOLIC CONTENT IN THE TINCTURE OF PROPOLIS OF UKRAINIAN ORIGIN

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Propolis consists of a complex mixture of resinous substances collected by honeybees from different plant sources. The most abundant compounds are phenolics including aromatic alcohols, phenolic acids and their esters (caffeic acid, cinnamic acid, p-coumaric acid and benzoic acid), flavonoids (chrysin, dihydrochrysin 2',6'-dihydroxy-4'-methoxy chalcon, galangin, and pinocembrin), and fatty acids. The typical raw propolis consists of 45–55 % plant resin, 25–35 % of wax, 5–10 % of essential and aromatic oil, 5% of pollen, 5% of other natural products, and secondary plant metabolites, which differ in concentrations depending on season, geographic origin of the collection and the proximity of a beehive to particular plant sources. Several groups of researchers documented that all types of propolis have antibacterial properties (Huang et al., 2014; AL-Ani et al., 2018).

The purpose of this work was to determine the total phenolic content in the tincture of propolis of the Ukrainian origin.

The propolis sample was collected in Ukraine on 16 September 2017. The hives were located in Vradvivka of Mykolajiv region. Propolis was extracted with 60 % ethanol at a ratio of propolis to the solvent 1:12 (w:v) for the appropriate time.

Tincture of propolis could be considered as a component of antimicrobial medicinal products, toothpastes, teeth elixirs against drug-resistant microorganisms.

Propolis is rich in phenolics. The quantity of phenolics could be used as a criterion to evaluate the quality of propolis. The total phenolic content (TPC) of the propolis tincture was determined according to the Folin–Ciocalteu assay and expressed in g of gallic acid equivalents per 1L of the tincture.

TPC of the tincture was determined according to the following analytical procedure. 100 µL of the tincture dilution (1:200) was mixed with 100 µL of the Folin–Ciocalteu reagent, later 1500 µl of purified water and 300 µL of 20 % solution of sodium carbonate were added. The mixture was mixed by vortex and incubation was done for 60 minutes at room temperature at the darkness. Absorbance was read at 760 nm using spectrophotometer «Genesys 20». Purified water was used as a blank. The test was carried out for the tincture in triplicate. The mean of three readings was used for calculations of mean TPC. The results were expressed as gallic acid equivalents: grams eq-gallic acid per 1 liter of the tincture. It was established that the prepared tincture contained a very high TPC: 15.849 g per 1 liter.

As a result of the performed studies, the TPC was determined in the tincture of propolis of the Ukrainian origin.

Keywords: propolis, Folin-Ciocalteu reagent, polyphenols.

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**ANTIOXIDANT ACTIVITY OF LEAF EXTRACTS OF
CRAMBE KOKTEBELICA (JUNGE) N. BUSCH AND *CRAMBE MITRIDATIS* JUZ.**

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Crambe koktebelica (Junge) N. Busch and *Crambe mitridatis* Juz. are one of the forgotten and underutilized germplasms for vegetable production. The chemical and biological features of these species show the necessity for their widespread introduction and cultivation in farming. The aim of this study was to investigate the antioxidant activity of water and methanolic extracts of *Crambe koktebelica* and *Crambe mitridatis* since antioxidants play an important role in food preservation by inhibiting oxidation processes and contributing to health promotion rendered by many dietary supplements, nutraceuticals, and functional food ingredients. Obtained results will be useful for the purpose of using them in farming also as medicinal and food plants.

Plant materials of *Crambe koktebelica* and *Crambe mitridatis* for studying were collected during expeditions to the Crimea in 2010-2013. Leaves of both species were collected from their *locus classicus* (in Karadag array for the first one and in the Kerch Peninsula for the second species). The amount of 1 g of dried and powdered leaves was extracted with methanol (25 ml) and distilled water (25 ml). The infusions were stirred on the magnetic stirrer at room temperature for 5 h. This was then centrifuged at 6000 rpm at 4° for 10 min and the supernatant was stored at -4° for further analysis. The antioxidant activity was determined by a spectrophotometric method based on a percentage of inhibition of DPPH radical (2,2-diphenyl-1-picrylhydrazyl). We determined the optical density of solutions in the interaction DPPH with extractive substances of plants by spectrophotometer "Genesis 20" at a wavelength of 515 nm.

The antioxidant activity of water extract of *Crambe koktebelica* was 50.17±0.44 %, the highest value of investigated species. Methanolic extract of *Crambe koktebelica* had a value of antioxidant activity 26.32±0.74 %. *Crambe mitridatis* water and methanolic extracts showed lower antioxidant activity 22.80±6.21 and 15.39±0.17 %. Accordingly, *Crambe koktebelica* plant material could be a potential natural source of antioxidants and could have greater importance as a therapeutic agent in preventing or slowing oxidative stress-related degenerative diseases.

The results demonstrated that both species can be used for the food industry because of their relatively high value of the antioxidant activity, especially water extracts. They are promising for use in fodder, food, decorative and medicinal purposes. These species have got 95 % germination of seeds, simple agrotechnology and combination of fairly high seed and fruit weight indexes with an average of actual seed productivity. Therefore, cultivation of *Crambe koktebelica* and *Crambe mitridatis* is sufficiently easy and doesn't need many investments.

Keywords: antioxidant activity, *Crambe koktebelica*, *Crambe mitridatis*.

Acknowledgments

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ASSORTMENT OF PHARMACEUTICALS BASED ON BEEKEEPING PRODUCTS IN UKRAINE AND REQUIREMENTS FOR THEIR QUALITY

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Beekeeping products such as honey, propolis, bee pollen, royal jelly, honey, bee venom, and other hive products are very often used for the treatment of different diseases in folk medicine and at the same time are raw materials for the pharmaceutical, food and cosmetic industry.

Thus, the aim of the study is to analyze the assortment of pharmaceuticals based on beekeeping products in Ukraine and summarize the requirements for their quality.

The objects of the study are pharmaceutical regulations, the State Register of Medicinal Products of Ukraine and the list of dietary supplements. Methods of data retrieval and generalization, mathematical and statistical analysis were used.

17 trade names and 28 medical forms and dosages of pharmaceuticals based on beekeeping products are included to the State Register of Medicinal Products of Ukraine in July 2019. These medicines are based just on three beekeeping products such as propolis, bee pollen, royal jelly, their combinations and combinations with other active substances. 60.7 % of all medical forms and dosages include propolis and 17.9 % has propolis in combination with other active substances. 10.7 % contains royal jelly. Bee pollen exists only in combination with propolis (7.1 %) or in combination with other active substances (3.6 %). The first and the second places among all the medical forms and dosages with beekeeping products occupy tinctures (21.4 %) and sprays (17.9 %). The third place belongs to suppositories, tablets, capsules, and ointments (each 10.7 %). At the last two places sublingual tablets, aerosols (each 7.1 %) and powder (3.6 %) can be found. 89.3 % of pharmaceuticals based on beekeeping products are locally produced. All the analyzed medicines were divided into 8 groups according to the ATC classification system. The biggest parts belong to the subgroups D03AX 'Other cicatrizants' (28.6 %) and A01AB 'Antiinfectives and antiseptics for local oral treatment' (25 %). 21.4 % of the analyzed medicinal products refer to subgroup C05AX 'Other agents for the treatment of haemorrhoids and anal fissures for topical use' (10.7 %) and R02AA 'Antiseptics' (10.7 %). They are followed by subgroups A16AX 'Various alimentary tract and metabolism products' (7.1 %), G04BX 'Other urologicals' (7.1 %), D11AX "Other dermatologicals" (3.6 %), N06BX "Other psychostimulants and nootropics" (3.6 %). 79 % of the analyzed medicines has an unlimited period of registration (only locally produced products). Analysis of pharmaceutical legislation shows that dietary supplements have less strict requirements for registration compared to medicinal products.

The results of these studies demonstrate that in Ukraine pharmaceuticals based on beekeeping products have a narrow product line, mostly presented by medicines with propolis. 89.3 % of medicines are domestically produced. Therefore, the development of medicinal and dietary supplements on the base of beekeeping product is a topical issue of current pharmaceutical science.

Keywords: beekeeping products, dietary supplements, quality requirements, Ukraine.



FRUIT PLANTS OF THE WORLD FLORA IN INTRODUCTION AND SELECTION STUDIES IN THE FOREST-STEPPE OF UKRAINE

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In nature, there is a significant variety of fruit plants of great value, such as high-quality fruit and productivity donors, resistance to abiotic and biotic factors, etc. In this regard, their search – a practical continuation of the begun M.I. Vavilov work on the systematic and rational use of plant resources of the planet. The expanding cultivation of new and non-traditional fruit plants that have adapted and regularly fetched will enable the production of high biologically active components fruit for the food and processing industry as well as raw materials for the pharmaceutical industry. The founders of the scientific selection of fruit plants and the involvement in the selection of wild species are L. Burbank (1955), N.I. Vavilov (1987), I.V. Michurin, in Ukraine – N.F. Kashchenko (1934). The Department of acclimatization of fruit plants of M.M. Gryshko National Botanical Garden (NBS) over 80 years conducts work on the introduction and selection of fruit plants.

The aim of the research is to substantiate the theoretical and practical aspects of introduction, selection, and use of biological diversity of fruit plants of the world flora for the creation of multicomponent cultures of phytocoenoses. The collection and selection fund of cultural and wild plants of the department is represented by 20 families, 37 genera, over 700 species and cultivars. The species from such families are studied: Actinidiaceae, Annonaceae, Berberidaceae, Caprifoliaceae, Cornaceae, Ebenaceae, Elaeagnaceae, Ericaceae, Fagaceae, Juglandaceae, Lardizabalaceae, Moraceae, Rosaceae, Rhamnaceae, Sambucaceae, Saxifragaceae, Solanaceae, Schizandraceae, Vacciniaceae, Vitaceae. Research methods: information retrieval, introductory, ecological-biological, phenological, comparative-morphological, biochemical, statistical; analytical, synthetic and clone breeding; comprehensive evaluation of perspective varieties.

The concept of adaptive introduction is substantiated. It was shown that when introducing the studied species on the basis of seed reproduction, the effects of natural and artificial selection from generation to generation, the adaptation of plants increases. To the State Register of Plant Varieties of Ukraine 62 cultivars are included: actinidia – 17, quince – 5, apricot – 2, cherry plum – 1, grapes – 1, cornelian cherry – 14, magnolia vine – 1, peach – 14, flowering quince – 4, guelder rose – 3.

The long-term introduction-selection work performances of M.M. Gryshko National Botanical Garden showed the possibility of the wide use of different species of world Flora of a different botanic-geographical origin for introduction and selection of perspective species of new, neglected and non-traditional horticultural and berry plants. The best cultivars of such plants species to the Register of cultivars of plants of Ukraine are included.

The department recommends new species and cultivars for cultivation in private, farmer and industrial gardens in Polissya, Forest-Steppe, and Steppe of Ukraine.

Keywords: fruit plants, new, non-traditional, introduction, selection, Forest-Steppe of Ukraine.



ANTIMICROBIAL AND SOME BIOCHEMICAL PROPERTIES OF *VACCINIUM VITIS-IDAEA* L.

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Over the past years, there has been a growing interest to vegetable raw materials evaluated from the viewpoint of their potential antimicrobial activity. *Vaccinium* L. genus plants are known to contain a whole spectrum of biologically active substances with anti-inflammatory, antidiabetic, gene-protective, antioxidant and antimicrobial properties.

The purpose of the work was to study the antimicrobial, antioxidant and some biochemical properties of alcoholic extracts of fruit and leaves of *Vaccinium vitis-idaea* L., gathered in the Ukrainian Carpathians. The plants for the study were gathered around the village of Pylypets, Mizhhiria district, Zakarpatska region (Transcarpathia). From the fruit and leaves, ethyl and methyl extracts were produced. The subjects for the study were their antioxidant activity (by DPPH method), total tannin and flavonoids (by spectrophotometric method), and antimicrobial activity (by diffusion-into-agar method). For the purpose of study, reference and clinical isolates were used from the oral cavity of human patients suffering from inflammatory diseases of the periodontium, characterized by wide resistance spectrum to antibiotics.

The studies have shown that the extracts displayed antimicrobial activity against Gram-positive bacteria. Ethyl extract of *Vaccinium vitis-idaea* fruit was established to display antimicrobial activity against clinical and reference strains of *S. aureus*, *B. subtilis*, *S. pyogenes*. Ethyl extract of leaves was seen to display a somewhat lower activity against *S. aureus* and *S. pyogenes*. Similar trends were shown for methyl extract of leaves. Less expressed antimicrobial activity was peculiar for methyl extract of the fruit.

The extracts were characterized by high antioxidant activity; the highest activity was displayed by ethyl leaf and fruit extracts, somewhat lower – by methyl extracts. Out of all extracts under review, it was the ethyl fruit extract that showed the highest level of tannins. The highest level of flavonoids was registered in the ethyl leaf extract; their quantity in the fruit extracts was 10 times lower. A low level of flavonoids was also registered in the methyl extracts. The tannin contents of the leaves of ethanol and methanol extract equalled to 3.906 and 3.451 %, respectively. The lowest level of tannins was peculiar for the methanol fruit extract.

Thus, the highest antibacterial activity was displayed by the ethyl extract of *Vaccinium vitis-idaea*. It is worth noting that the extracts displayed antimicrobial activity against both reference and clinical isolates of *S. aureus*, including methicillin-resistant ones. The ethyl fruit extract and methanol leaf extract were established to show antimicrobial effect against *S. pyogenes*. The ethanol fruit and leaf extracts and methanol fruit extract were observed to show weak antimycotic activity. The fruit extracts were characterized by low antimycotic activity. The established regularities cause good prospects for further studies of the use of *Vaccinium vitis-idaea* as a source of substances with antimicrobial activity against antibiotic-resistant representatives of opportunistic microbiota.

Keywords: antimicrobial properties, antioxidant activity, *Vaccinium vitis-idaea* L.

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DARK FOREST BEES IN POLISSYA OF UKRAINE

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The dark or black (*nigra*) forest bee, which is common in the Ukrainian Polissya, is a population of the European black (dark) bee (*Apis mellifera mellifera*), a subspecies of honey bee (*Apis mellifera*). In the Ukrainian Polissya, this bee lives in a wild state in hollows. It is also kept in beehives. The dark forest bee was formed in the harsh climatic conditions of Polissya, and therefore is characterized by high winter resistance and resistance to diseases. It is a valuable genetic material. After the accident at the Chornobyl Nuclear Power Plant, people were resettled from a large part of the Ukrainian Polissya and the colonies of these bees were abandoned. This led to a decrease in their population. Therefore, the dark forest bee needs to be repopulated and studied her biological and economic characteristics, which became the aim of our research.

The research, the object of which was the colonies of the dark forest bee population, was conducted in the Polissya Natural Reserve of Ukraine. The determination of biological and economic characteristics of bee families was carried out according to generally accepted methods.

It is found that at present the largest number of dark forest bee families is concentrated in the Polissya Natural Reserve, located in Ovruch and Olevsk districts of Zhytomyr region. There are 1800 colonies kept in wild hives. These bees have a dark gray color, without yellowness. The average weight of one-day bees is 110 mg, the weight of a virgin queen is 190 mg, of a laying queen, is 210 mg, the length of the proboscis of a worker bee is 5.9–6.3 mm, of the third tergite, is 5 mm, the cubital index is 1.4–1.9, discoidal displacement is negative. The spring development of bee families begins late, but occurs quickly and ends by mid-June. In the period of intensive development of queens have a high reproductive capacity – 1500–2000 eggs per day. These bees cap honey with a white (dry) capping, propolize bikes moderately and have increased aggressiveness. During the inspection of bikes bees are very excited, go down hanging in clusters on the lower bars of the frame. Bees are very full of swarms. 80–90 % of all bee families in the apiaries are in the full of swarms state. The average number of capped queen cells is 25–30. When destroying queen cells or by a sharp expansion of a bike the swaddlings do not stop until there is a honey flow with an intensity of 2.5–3.0 kg per day. The honey performance for keeping in wild hives is 10–15 kg.

Thus, biological and economic characteristics of the bee families under research correspond to a dark forest bee. The Polissya Natural Reserve of Ukraine focuses on 1.800 colonies of these bees. They can be a genetic reserve for use in breeding with the improvement of existing and the removal of new breeds with high winter resistance and resistance to diseases.

Keywords: dark forest bee, the Ukrainian Polissya.

EFFECT OF ENDOPHYTIC *BACILLUS SUBTILIS* AND SALICYLIC ACID ON RESISTANCE OF *SOLANUM TUBEROSUM* L. (POTATO) TO POSTHARVEST DISEASES

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Postharvest diseases of potato lead to significant food and economic losses worldwide. In this work we analyzed the effect of beneficial endophytic bacteria *B. subtilis* (strains 10-4 and 26D) both individually and in combinations with the natural signal molecule salicylic acid (SA) on resistance of potato to diseases caused by *Phytophthora infestans* (late blight) and *Fusarium oxysporum* (fusarium wilt and dry rot) during storage.

The experiments carried out on hydroponically grown potato (*Solanum tuberosum* L., Cv. Bashkirsky) mini-tubers which before storage were infected by *Ph. infestans* (10^8 spores/mL) and *F. oxysporum* (10^6 spores/mL) and then with *B. subtilis* (10-4, 26D) in wide range of concentrations (0, 10^3 , 10^4 , 10^5 , 10^6 , 10^7 , 10^8 CFU/mL) both alone and in mixes with SA (0.05 mM), and stored for 3-5 months at $3\pm 1^\circ\text{C}$. All microbiological, molecular and physio-biochemical parameters were assessed using classical and modern methods of investigations.

It was revealed the dose-dependent nature of *B. subtilis* (10-4, 26D) activity against diseases of potato during storage both individually and in mixes with SA. The most effective concentrations of *B. subtilis* in the suppression of both *Ph. infestans* and *F. oxysporum* are 10^8 CFU/mL (10-4 and 26D), 10^7 CFU/mL (10-4+SA) and 10^6 CFU/mL (26D+SA) were found. The ability of *B. subtilis* (10-4, 26D) effectively penetrate and colonize the internal tubers' tissues when applied immediately prior to storage and the ability of SA accelerate these processes has been proven. Application of *B. subtilis* 10-4, 26D and their mixes with SA significantly increased the activity of amylase (AMY) inhibitors both in healthy and *F. oxysporum*-infected tubers during storage. While in tubers infected by *Ph. infestans* the AMY inhibitors' activity were almost zero in the variants (control (without bacteria), 10-4 and 10-4+SA), in variants 26D and 26D+SA were slightly increased. At the same time, *B. subtilis* (10-4, 26D) had practically no effect on the activity of protease inhibitors or in some cases (26D upon infection *Ph. infestans* and 26D+SA upon infection *F. oxysporum*) contributed to a slight decrease in their activity. Also, found that *B. subtilis* 10-4, 26D and their compositions with SA decreased pathogens-induced glycoalkaloids (GA) (solanine and chaconine) accumulation and significantly increased ascorbic acid (AA) content (especially when *B. subtilis* applied with SA) in both healthy and infected tubers during storage.

Thus, obtained results indicated that *B. subtilis* 10-4, 26D and their combinations with SA effectively suppress the development of *Ph. infestans* and *F. oxysporum* in potato tubers during storage prolonging shelf-life and positively impact on the quality of stored products.

Keywords: Endophytic *B. subtilis*, *Solanum tuberosum* L., *Phytophthora infestans*, *Fusarium oxysporum*, resistance and quality parameters.

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APITOURISM IN CONTEXT OF SOCIO-ECONOMIC AND ECOLOGICAL ASPECTS

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At the beginning of the third millennium, the tourism industry turned into a powerful highly profitable industry, a type of economic activity, a branch of knowledge, a socio-cultural phenomenon, in which the economic and social interests of society, business structures, and consumers were closely intertwined. The tourist industry is a powerful socio-economic and political factor that determines the development of the economy and policies of many countries and regions of the world.

The objects of study are rural tourism and its direction as apitourism. These popular forms of recreation are an important part of the tourism and services market. In modern conditions, rural green tourism and apitourism are becoming more and more important throughout the world and is one of the most promising and effective areas for sustainable development of rural areas.

The methodological basis of the research is the method of analysis and synthesis.

The positive impact of rural tourism on solving the socio-economic problems of the village is that it expands the employment of the rural population, especially women, and gives peasants extra wages, expands the opportunities of employment of the farmer, not only in the production sector but also in the service sector. Rural green tourism is not only a plus for the economy, environmental protection, improvement of the ecological situation, as well as the creation of new jobs, which stimulates the influx of young professionals into rural areas.

The experts of the World Tourism Organization agree that rural tourism is a complex multidimensional activity that includes hiking, mountain climbing, and mountaineering, horseback riding, sports and health tours, hunting and fishing, as well as other, less specialized forms of tourism, in particular, apitourism.

Beekeeping in Ukraine is a traditional sector of agriculture. Every countryside has an apiary and family of beekeepers, which are is good educated, hospitable and successful people.

Apitourism – one of the types of rural tourism, involves living in agro farms or directly in the apiary of the beekeeper, tasting, consumption, bee products. Tourists also have the opportunity to get acquainted with the technology of production of these products, to observe the life of the bee family and at the same time carry out apitherapeutic procedures.

The atmosphere and positive energy of apiaries make them real natural oases, the best place for rest, recreation and relaxation. So, apitourism has the best prospects for its development in countries where beekeeping is a historical, traditional branch of agriculture. Fortunately, it is to such countries that Ukraine can be attributed.

The results demonstrate the attracting beekeepers, farmers, owners of private farms to rural tourism, including apitourism, helps, on the one hand, to increase the profitability of apiculture, and on the other – to raise the level of their culture, to contribute to the development of the tourism industry and to preserve the best national traditions for future generations.

Keywords: socio-economic problems, rural tourism, apitourism, recreation.



HOMOGENATE OF DRONE LARVAS – BIOLOGICALLY VALUABLE FOOD PRODUCT

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Homogenate of drone larvas is not synthetic, but the natural product, so it should be included in the diet as a nutritional protein food that is not inferior to animal meat, and even exceeds its content of microelements and vitamins. As a separate biologically active food homogenate of drone larvas are relatively new, which interests scientists and nutritionists with its properties. Analyzing the work of scientific institutions and individual scientists on the qualitative and quantitative composition of a homogenate of drone larvas, we noted inconsistencies in the results obtained by them. For example, Lazarian in his work (2002) indicates that homogenate of drone larvas has 38.5 % of protein content and Grechka (2005) notes this index in the amount of 13.0 %. Burmistrova (2009) indicates that its active acidity (pH) level of a homogenate of drone larvas ranges from 4.8 to 6.7, whereas Prohoda (2007) notes that this neutral (pH-7). The same trend is observed with the content of hormones. Thus, Osyntseva (2012) found that the amount of testosterone and estradiol in the body of 5-6 day old larvas is 8.19 and 274.50 nmol/liter, respectively, and in studies of Bogdanov (2016), these figures are indicated in quantity of 0.31 and 677.6 nmol/100 grams, respectively.

Therefore, the purpose of our work was to investigate the homogenate of drone larvae of different ages by biochemical composition.

The study of these tasks was initiated at the industrial apiary of BEEHIVE Company in May 2019. The material for conducting research homogenates of drone larvae aged from 5 to 8 days.

The protein content of the drone larvae homogenate was found to be 14 % dependent on age, its active acidity (pH) level ranges from 5.68 to 6.44, and the flavonoid compounds ranged from 0.73 to 1.8 %. The mass fraction of crude fat in the homogenate of drone larvae of 8-day age is 2.28 %.

So, now it is scientifically proven that homogenate of drone larvas contains a large number of biologically active substances, but the dynamics of the transformation of quantitative and qualitative composition, considering physiological stages of drone larvas in colonies of different breeds (races) in various climatic conditions of Ukraine, is still not sufficiently studied. The very technology of homogenate of drone larvas production needs to be improved in view of these figures.

Keywords: bee colonies, chemical composition, homogenate of drone larvas.



OATS – A CROP FOR FUNCTIONAL NUTRITION

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The evaluation of cereals genetic resources is important for the selection of source material for plant breeding. Recently, the most important directions of breeding for oats are, in addition to grain productivity, grain characters associated with properties for functional nutrition. The traditional directions of breeding these crops are increasing the content of protein, lysine, and starch, and the dietary properties of grain are now in demand. The grain quality of oats depends on the resistance to fungal diseases. Diseases not only reduce the grain productivity of crops but also worsen crop quality due to the accumulation of toxic metabolites. *Fusarium* of grain – a disease that, first of all, significantly reduces the quality of products and their safety. Mycotoxins that accumulate in the kernels reduce the consumer properties of these crops and, when used, adversely affect human and animal health. Many researchers note that naked varieties of oats are more resistant to grain damage by fusarium and less accumulate mycotoxins.

Complex field and laboratory evaluation of accessions of cultivated species of the genus *Avena* L. collection at VIR were conducted. When studying samples of oats of grain contrasting in parameters of resistance to fusarium (joint work with VIZR) on protein content, oil, fatty oil composition, a negative correlation relationship was found between protein content in oat grain, the linolenic acid content in oat oil and infection with fusarium. Conducting of joint research with the Department of Biochemistry and Molecular Biology of VIR on biochemical characteristics allowed us to identify high-quality genotypes of oats. The results of the metabolic analysis revealed a variety of spectra at the species and intraspecific levels. It was found that naked oat varieties had large total indicators for organic, fatty and amino acids, sterols, disaccharides, and total sugars, and covered varieties had high values only for monoacylglycerols, polyatomic alcohols, and monosaccharides. A large variety of metabolic spectra was found at the species level of cultivated oats and between varieties of different levels of breeding. The analysis of the micronutrient composition (joint research with St-Petersburg State University) in *A. sativa* L. accessions showed genotypes with a high content in the groat of such essential elements as Fe, Zn, and Mn.

Therefore, the global oat collection at VIR is an essential and valuable source of material for ensuring food, bioresource, and ecological security, as well as for functional food. Thus, varieties of oats with increased level of economically valuable traits and quality parameters of grains, such as increased content protein, oils with well-balanced fatty acid composition and micronutrients, as well as resistance to fusarium infection and free from mycotoxins, can be sources for breeding of new varieties to improve the quality of grain for the production of safe high-quality, dietary and functional foods.

Keywords: oat, *Avena*, *Fusarium*, breeding, functional nutrition.

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RESOURCE POTENTIAL OF *SAMBUCUS NIGRA* L. IN CHERNIHIV POLISSYA (UKRAINE)**Oleksandr Lukash**

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Sambucus nigra L. has a wide range of uses. Fruits of the species are used for making confitures, jellies, juice and also for the extraction of dyestuffs. The flowers are also used in the preparation of drinks and medicines. Dried fruits, flowers and cortex of this bush have been used as diaphoretic and diuretic medicines. The medicinal properties of *Sambucus nigra* and its toxicity have been known since antiquity, and have also been used as a source of natural pesticides. The products of *Sambucus nigra* (sambucol) are natural remedies with antiviral properties, especially against different strains of influenza virus.

The aim of the study was to determine the *Sambucus nigra* habitats that can be the potential for the collection of the raw material of the plant in Chernihiv Polissya. The field study during 2010–2018 was carried out by the geobotanical methods. 28 phytosociological relieves were made.

Sambucus nigra occurs in the whole of Europe (with the exception of the northern parts of the continent) and also in Africa and Southwest Asia. The approximate latitudinal limits of its native range are 34 to 63 °N. The natural habitats of *Sambucus nigra* in the territory of Ukraine occupy the Forest-Steppe, Zakarpattia, and Prykarpattia. This species grows rarely in natural phytocenoses of Polissya and the Carpathians. In Chernihiv Polissya it grows as a casual apophyte. Its distribution has a somewhat invasive character. It colonizes man-made leafy forests and many habitats of the species have an anthropogenic origin. The fast-growing shrub grows mainly on black earth, grey forest, pratal and peaty soils near the accommodation and stock-raising complexes. *Sambucus nigra* forms the communities in the areas of 200–600 m². The largest phytocenoses with prevailing of the shrub were formed near the abandoned houses, farmsteads and stock-raising buildings that had not been used for decades. Under such circumstances, *Sambucus nigra* (with the projective cover of 30–60 %) formed the shrub layer of the ruderal phytocenoses. *Urtica dioica* L. formed the herb layer (the projective cover is up to 25–40 %). The species with the projective covering of 2–3 % are *Artemisia vulgaris* L., *Elytrigia repens* (L.) Nevski, *Leonurus quinquelobatus* Gilib. ex P.Usteri, *Anthriscus sylvestris* (L.) Hoffm., *Geum urbanum* L., *Chelidonium majus* L., *Glechoma hederacea* L. Other ruderal species are well represented in the communities too. The effects of *Sambucus nigra* invasion have been quantified. The communities of *Sambucus nigra* were found in 21 settlements on the territory of Chernihiv Polissya (the Horodnia, Ripky, Chernihiv, Kozelets districts of the Chernihiv region). The general area of the communities is about 10 ha. For example, the productivity of one bush in the Burivka village (the Horodnia district) makes 200–300 g of dry flowers and 15–20 kg of fruits.

Thus, the ruderal phytocenoses dominated by *Sambucus nigra* in Chernihiv Polissya are the resource potential for the flowers and fruits of this fast-growing shrub laying in. In addition, the organization of laying in of *Sambucus nigra* raw material in the abandoned farmsteads will allow solving a number of social problems of the rural communities.

Keywords: *Sambucus nigra* L., resource, Chernihiv Polissya, vegetation.



USING AN AZO COUPLING REACTION TO DETERMINE 2,6-DIMETHOXYANILINE BY METHOD HPLC

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The 2,6-dimethoxyaniline (DMA) is the product of biodegradation of many pesticide active ingredients: matrine (Bayer), callisto (Syngenta), etc, which have or have had wide application in agriculture for the cultivation of various crops. MA is a yellow powder with melting point 71–74 °C, boiling point 254 °C, density 1.096 g/mL, refractive index 1.4770 (at 80 °C). In addition to pesticides, DMA is an intermediate commonly used in the synthesis of dyes, pigments, pharmaceuticals, and other important products. DMA has toxic and carcinogenic properties. To convert DMA into the hydrophobic form and improve its metrological characterization, the derivatization reaction with 4-nitrophenyldiazonium cation was used which results in the formation of DMA azo compound. The formation of azoderivate largely depends on the pH of the medium. To study this effect, the derivatization reaction was performed in a wide range of hydrogen ion concentration: of 3.7 to 13.4 pH. Important for the formation of DMA azo compound is the reagent concentration. To study this impact, a series of experiments were performed, with the concentration of diazonium cation varied from 1 to 30-fold amount relative to the DMA amount. The IR spectra were recorded by Abatop (Nicolatt, USA) spectrometer with KBr pellets. Liquid chromatography was carried out using Perkin-Elmer (USA) chromatograph with a spectrophotometer detector. A stainless steel column (250×4.6 mm) was filled with Silasorb The chromatography was performed in isocratic elution mode: mobile phase content acetonitrile water = 2 : 1; flow rate 1.2 cm³/min; λ = 389 nm; sample input 20 μ L. The chromatography results were processed using the “Multichrom” and “Millenium” software. For extraction and retrieval of azoderivate, several organic solvents (hexane, toluene, o-xylene, dichloromethane, chloroform, dichloroethane, ethyl acetate, butyl acetate, isoamyl acetate) were studied. The best extragents were dichloromethane and chloroform. For practical purposes, chloroform was used. The extract was examined chromatographically. The retention time was 8.1 minutes; a single symmetrical peak was observed indicating that no imposition of impurities occurs, which otherwise would prevent the determination. The triazene was prepatively isolated. The solid residue – triazines DMA – was analyzed for the content of carbon, bromine, hydrogen, and nitrogen. The elemental analysis confirmed the triazene composition. The structure of synthesized triazene was also confirmed by IR-spectroscopy; in particular by absorption at 1575, 1596 cm⁻¹ due to stretching vibrations of a hydrogen atom bonded to a nitrogen atom in the triazene >N-H group. The dissociation constant of the imino-group proton is calculated from pH-dependent changes in the absorption of triazene solutions at maximum absorption of anionic form. The linear dependence of the chromatographic peak area on DMA concentration was observed in the range 30–4200 mg/dm³. Based on these data, the methods to determine DMA in soils and wastewater using high-performance liquid chromatography were developed and tested on model samples and real objects. The metrological processing of the results was made. This simple, sensitive and accurate method provides an alternative way to rapidly analyze and monitor DMA in soils and wastewater samples. The method, if suitably modified, can be used to determine the DMA and other objects at some refinement analysis techniques.

Keywords: 2,6-dimethoxyaniline, azo coupling, HPLC, determination.



ECOBREED-INCREASING OF THE EFFICIENCY AND COMPETITIVENESS OF ORGANIC CROP BREEDING

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The availability of organic seeds and varieties (including cultivars) is an economic and technical challenge for organic producers. It is estimated that more than 95 % of organic production is based on crop cultivars that were bred for the conventional sector and consequently lack important traits required under organic and low-input production conditions. The H2020 ECOBREED project aims at increasing the availability of seed and varieties suitable for organic and low-input production. Activities focus on four crop species of the organic sector, i.e. wheat (*Triticum aestivum* L. and *T. durum* L.), potato (*Solanum tuberosum* L.), soybean (*Glycine max* (L.) Merr), and common buckwheat (*Fagopyrum esculentum* Moench.).

The project will develop (a) methods, strategies and infrastructures for organic breeding, (b) varieties with improved stress resistance, resource use efficiency, and quality and (c) improved methods for the production of high-quality organic seed.

In these procedures especially the analytical a pragmatic approach has been used by passport descriptors (i.e. by ECPGR or Bioversity International), country of origin, breeder, heading and selected traits the most important for the organic production, accessions with and high reputation which plays an important role in breeding history, availability of material and by the project aims ECOBREED. To make efficient use of large germplasm collections, the concept of core collections has been proposed. Various types of data including passport data, geographic origin, agronomic traits, and molecular markers we used for selecting a core set.

In the first part of the project, we identified, establishing and multiplying the core collections for the 4 crop species. We performed phenotypic characterization of the species core collections which will be used in breeding programs to produce varieties for organic agriculture. ECOBREED enhance the portfolio of wheat, potato, soybean and buckwheat varieties suitable for organic farming in Europe and identify traits and combinations of traits suited to organic and low-input farming. They foster low-input agriculture, the sustainability of farming practices and quality of products which meet consumer expectations. Conventional systems will also benefit from varieties which are better adapted to lower resource inputs and are more resilient to variable environmental conditions.

Keywords: wheat, potato, soybean, buckwheat, biotic/abiotic stress, phenotyping, genotyping

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**POLYPLOIDY INDUCTION IN GIANT MISCANTHUS
(*MISCANTHUS* × *GIGANTEUS* GREEF ET DEU.)**

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Soil and climatic conditions of most regions of Ukraine are favorable for cultivation of perennial energy plants, such as a natural hybrid giant miscanthus (*Miscanthus* × *giganteus*) (Rakhmetov, 2015). From genetic point of view, *M. × giganteus* is a sterile allotriploid originated from hybridization between *M. sacchariflorus* and *M. sinensis* (Rayburn et al., 2009; Chramiec-Glabik et al., 2012). This leads to problems with its sexual reproduction and, thus, limits realization of breeding programs for improvement of agronomic traits of this species. The only way to overcome the problem is obtaining of fertile polyploid forms (Yu et al., 2009). Moreover, in most cases, polyploids are characterized by a larger cell size and perform better compare to original plants in biomass yield (Birchler et al., 2003).

Thus, the aim of the work was to obtain polyploid lines of *M. × giganteus* *in vitro* using new antimitotic compounds of dinitroanilines class (Ozheredov et al., 2009; Melnychuk et al., 2016) and subsequent study of biological and biochemical traits of new lines.

Polyploidization of *M. × giganteus* has been conducted by cultivation of shoots *in vitro* on micropropagation media supplemented with antimitotic agents at various concentrations (3, 5, 10, 25 and 50 μM) for 7 and 14 days, followed by transfer to medium free of antimitotics. Cultivation conditions were 16/8 h photoperiod and temperature 24 °C. Ploidy level of obtained lines was determined by counting chromosome number in root tips apical meristem.

According to the results of the work, it was shown that new compounds of dinitroanilines class have a significantly lower level of phytotoxicity compared to the classic dinitroanilines, such as oryzalin and trifluralin. All of compounds used in the work proved to be able to induce polyploidy in *M. × giganteus*. As a result, lines of *M. × giganteus* with increased ploidy level have been obtained. Analysis of their biological and biochemical traits in comparison with original forms has been conducted and the most promising lines for further application have been determined. Further analysis and study of fertility and reproduction of the lines is underway.

Keywords: *Miscanthus*, polyploidization, *in vitro*, antimitotic agents, dinitroanilines, biofuel feedstock.

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OPPORTUNITY FOR CREATING STONE PINES' ORCHARDS IN UKRAINE PREREQUISITE FULFILLED

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In Ukraine, the climate conditions are fit for growing eighth species of pines with edible seeds: *Pinus albicaulis* Engelm., *P. armandii* Franch., *P. cembra* L. *P. flexilis* E. James, *P. edulis* Engelm., *P. koraiensis* S. & Zucc., *P. sibirica* Du Tour., *P. pumila* (Pall.) Regel. The plants of stone pines were observed during the last ten years. Our tasks were taking information about the success of pollination as well as seeds quality. The method of Rugusov (1996) was used to determine pollinated ovules. The seeds quality was assessed counting empty and full seeds by cutting them. The method of Owens (2007) for finding out reasons for ovules lethality after pollination was applied. Moreover, we have observed visual damages from insects and diseases.

This article is demonstrating the results from five Ukrainian and one Slovak site. All the plots are situated in different climate conditions, from Ukraine Steppe with 530 mm precipitation yearly to Ukrainian Carpathians with 1000 mm.

Mariupol station is the East-most place in Ukraine where we have observed standalone trees (which are grafted to *P. nigra* subsp. *pallasiana* (Lamb.) Holmboe) of six species: *Pinus koraiensis*, *P. armandii*, *P. sibirica*, *P. cembra*, *P. pumila*, *P. edulis*. All these plants are 10–12 years old; they have been cultivated without watering and have been damaged by red pine sawfly (*Neodiprion sertifer* (Geoffroy)). The male cones were produced by Korean and Armand pines for 4 years' age. M.M. Gryshko National Botanical Garden of the National Academy of Sciences of Ukraine (Kyiv) has two plots of *P. sibirica* that are more than 60 years old. These trees have been severely damaged by insects from genus *Pineus* Shimer yearly. Some trees have had up to 120 cones. The pollinated ovules' ratio is different each year (from 0 to 40 %). 34 trees of Korean pines (same age as Siberian) are growing in the botanic site 'Far East'. The part of full seeds was 22.7 and 43.6 % in different years, the part of not pollinated ovules were 40.9–98.1 %. The mixed plantations with *P. koraiensis* were created in 1983 on an area 3.2 hectares in Halych National Nature Park. The part of full seeds was 87.3 and 95.0 % in different years, the part of not pollinated ovules were 21–29 %. The geographic plots of stone pines were created in 1986 in Dendrology Park 'Vysokogirnyi'. Siberian pines aren't as good as European one: in these conditions, they have lost part of needles. Korean pines had 93 % of full seeds, not pollination ovules have contented 23 %, Siberia pines had 79.1–98.8 % not pollinated ovules, dwarf stone pines had 41.9 %, European pines 63.4–90.6 %. The biggest plots of Armand pine were observed in 2015 at the Mlyňany Arboretum, which is situated in the southern part of Slovakia. Five groups of pines and one solitary growing tree are approximately 5 m high. The ratio of pollinated ovules approximated 50, 70–75 and 90–100 % in different groups.

The success of pollination and seeds production depends on the age and number of trees. The best result was observed with Korean pines. The Siberian pines' results are unexpectedly the worst.

Keywords: stone pines seeds, success of pollination.



RELATIONSHIP OF QUALITY INDICATORS OF SOFT WHEAT VARIETIES DEPENDING ON THE GRAIN COLOR

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The white wheat varieties of soft wheat have a short post-harvest ripening period and have an undesirable property, germination at the root, which negatively affects the quality and taste of bread.

The material of the study was the red grain and white grain varieties of wheat, of an intensive type. The varieties were grown in the conditions rainfed (Jalilabad region) and irrigation (Tartar district). Baking quality was determined by laboratory baking. the Volume and the quality of bread estimation on a special scale for the quality of bread.

The content of gluten white-grained more than red-grained varieties. Among the red varieties, the minimum indicator of the amount of gluten in both the 2016th and the 2017th year was in the Zirva 85 variety (22.4 and 24.8 %, respectively, by years), but it is estimated that the quality of bread, in this variety, is not much inferior to other varieties. The indicator of the amount of gluten of the Fatima variety (23.2 and 26.4 %, respectively, by years) is not high, but the bread quality (450–400 cm³ per year, respectively) did not affect the quality of gluten, difference in the gluten index was very low 94.2–92.8 ea. The quality of bread in 2016 was 4.7 points, but in 2017 it was 3.3 points. The highest score of bread quality in both red and white grape varieties was 4.8 points. Correlation analysis showed that in 2016, there was no correlation between the indices of communication. In 2017 a negative correlation was established between the yield and the volume of bread ($r = 0.755$). Correlation with gluten content and the quality is positive ($r = 0.861$) connection.

Studies have shown that the difference in grain nature of red varieties is 26 g higher and only 3 g for flour yield. All other indicators for white-grained varieties are higher.

The correlation between grain quality indicators, depending on the color of the grain, was different. In white-grained varieties, a high positive correlation was found between the content of gluten and IDK ($r = 0.897$), volume and quality of bread ($r = 0.988$). Due to a small sample of varieties, the correlation was not reliable between the other parameters. Red grained varieties had a negative correlation between the yield of flour and the sedimentation index ($r = -0.933$).

Thus, the data show that the conditions of our republic can be considered favorable for the cultivation of white-wheat varieties of wheat since they are inferior to red-grained only by the output of flour.

Keywords: quality, wheat, flour output, bread, grain nature, correlation.



SOCIO-ECONOMIC ASPECTS OF UKRAINE BEEKEEPING DEVELOPMENT

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Only a highly qualified specialist can provide effective functioning of the beekeeping industry. The evidence for this is the multi-level education in the branch and first place in the ranking of European countries for the production and export of honey as well as the availability of innovative technologies of production of other beekeeping products. To your attention the experience of Ukraine in the training of specialists from qualified employee to the Doctor of Science in beekeeping.

The professional education of 1st grade, namely the beekeeper qualification can be obtained in the seven education institutions of Ukraine. The education is free, the students take the course of the profession of the beekeeper. Secondary special education for the educational degree of junior bachelor 'Beekeeping' can be obtained in Chernyatin College of Vinnitsia National Agrarian University. Higher education in beekeeping can be obtained only at the National University of Life and Environmental Sciences of Ukraine on the Faculty of Livestock Raising and Water Bioresources. According to the Law of Ukraine 'On Higher Education' there are 2 educational degrees – a bachelor and a master's degree. The term of study at the baccalaureate depends on the basic training, after the school – 4 years, technical school – 3, college – 2. During the magistracy, students are studying on the specialization of 'Technologies of productive use of the potential of bee family' for 1.5 years.

In our everyday work, we combine three components - traditionalism, rationalism, and innovation. Speaking about traditionalism, many of the sacramentals were proposed by the first head of the department V.A. Nestervodskyi. A tradition was continued by his student, Professor V.P. Polishchuk who created a scientific school.

Rationalism is represented by us teaching students not only what we know and like, but also what is needed in manufacturing. This distinguishes professionals from amateurs. So, we implement applied training, we demand skills of new innovative production technologies, convince students that their knowledge is the engine of innovation for the development and improvement of the economic efficiency of the industry. We give practical advice on how to use this knowledge in specific production situations. Students fill out questionnaires about the shortcomings and benefits of such approaches, we take this into account for further improvement. We are deeply convinced that the problem allows us to move forward. Therefore, students have the opportunity to reason, defend their own thoughts, find compromises, give examples of successful enterprises on specific issues of the industry, and themselves develop projects for the development and improvement of beekeeping farms.

Keywords: education, beekeeping, development, highly qualified specialist.

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CONTRIBUTION OF THE DEPARTMENT OF CULTURAL FLORA OF M.M GRYSHKO NATIONAL BOTANICAL GARDEN OF UKRAINE IN CONSERVATION, ACQUISITION AND EFFICIENT USE OF NEW PHYTORESOURCES

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In the context of global climate change, the development of measures aimed at reducing their negative impact on the biosphere as a whole, and on its individual components, in particular, is important. It is known that the plant world has a huge potential, but mankind uses only about 5 % of plant species. Today the issue of creating new crops and plant varieties, adapted to changing climatic conditions, became relevant. The withdrawal of new crops will solve such issues as providing humanity with balanced food, technical, energy and medicines, and livestock – high-quality feeds.

Through a comprehensive study of introduced resources of useful plants in the Department of Cultural Flora of the M.M. Gryshko National Botanical Garden of the National Academy of Sciences of Ukraine (NBG) has been created a rich collection of plants (about 2,5 thousand samples). The department is well-known in Ukraine and abroad, a scientific subdivision that develops theoretical and applied principles of phyto-introduction and phytoenergy, preservation, enrichment and effective use of new phytosanitary resources for improving the quality of life. The important contribution of the department is to establish the basic rules of optimization of production and metabolic processes in new plants and accumulation of phytoenergy, valuable substances in highly adaptive producers, introduction of culture of target plants with exceptional properties (about 60 species), creation of new crops (about 20), varieties and hybrids (100) and the development of innovative phytotechnologies (more than 50) that have been introduced, in addition to our state, even in 8 countries of the world. The department has created a unique collection fund of energy and aromatic plants, which are attributed to the scientific objects that make up the national heritage of Ukraine.

During the last period, the department received significant scientific results: biological and morphological, ecological, biochemical and allelopathic features, stages of ontogenesis and organogenesis, seasonal rhythms of growth and development of plants, depending on the vegetation conditions, new methods of rational use of introductory resources of little-known economically valuable crops have been developed and implemented. By various introductive, biologically-morphological, selection, biochemical, and biotechnological methods it was possible to achieve a significant improvement in the introductory process by increasing the adaptability of economically valuable crops (families Asteraceae, Brassicaceae, Malvaceae, Poaceae). These are mainly representatives of the genus of *Miscanthus*, *Panicum*, *Silphium*, *Malva*, *Sorghum*, *Brassica*. As a result, a number of forms and plant hybrids have been created with increased resistance to new environmental conditions, with significantly better qualitative, quantitative and productive characteristics. New crops were developed, highly adaptive genotypes were created and new phytotechnologies were assessed regarding the cultivation and use of raw materials of introduced plants. Due to the introduction of new useful plants in cultivated phytocoenoses, different from traditional crops with unusual properties, effective use of soil-climatic, ecological, the economic potential of the region of implementation has been achieved.

Keywords: new phytoresources, conservation, enrichment, efficient use.

CELL CYCLE REGULATION AND PROAPOPTOTIC ACTIVITY OF *PHALLUS IMPUDICUS* L.

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Apoptosis and cell cycle regulation are the main processes for maintaining the state function of the cell. Studying in this sphere is actual because these processes determine the exact reproduction of genetic information in daughter cells and eliminate cell transformation. The programmed cell death is evidenced by the expression of genes responsible for the synthesis of proteins involved in the biochemical cascade of apoptosis reactions, in particular, caspase-3, p53, and the anti-apoptotic protein Bcl-2, the analysis of which involvement in molecular mechanisms under the influence of *Phallus impudicus* L. extract on the cell cycle we studied. In traditional medicine *Ph. impudicus* use for the treatment of different illnesses, cardiovascular diseases, cancer, diseases of the reproductive system, during chemotherapy and radiotherapy to prevent metastasis and recurrence oncological illness. Scientists research separate biological active compounds involved in proapoptosis, anti-proliferative activities as to cancer cells. As *Ph. impudicus* have wide variety of valuable pharmacological properties, it is interesting to examine its toxicity, mechanisms interacting with cell's DNA.

The goal is to investigate the induction of apoptosis in *GC-1 spg*, *GC-2 spd* cells under the influence of *Ph. impudicus*, studying the expression of proteins: caspase-3, p53, Bcl-2, changes in the profile of the cell cycle. For research were used two mouse cell lines: spermatogonia germ cells *GC-1 spg* and spermatocyte cells *GC-2 spd* under the influence of 3 % *Ph. Impudicus* extract. Also, the object of research is gene expression in mentioned cells. For experiments, cells were treated with 3 % *Ph. impudicus* extract prepared by direct dilution in the cell culture medium. The cell cycle was profiled using DNA Cell cycle plug-in from ImageJ software on fluorescent microphotographs taken on InCell Analyzer 2000. The protein expression was examined by Western-Blot analyze.

The results of our studies are inhibition of the cell cycle of the 3 % *Ph. impudicus* extract of cell lines in the G₀/G₁ phase. For the *GC-2 spg* cell number of cell in G₀/G₁ phase increased by 11.7 % and on the other side we have reduced the number of cells in the G₂/M phase by 31.3 % relative to the controls. The *GC-1 spg* cell line reacts similarly only with lower numerical values: in the G₀/G₁ phase, the number of cells increases by 5.2 % due to a decrease in the number of cells in the G₂/M phase by 16.8 % relative to the controls. Increased expression of caspase-3, p53 under the influence of extract after 96 hours of incubation and reduction of Bcl-2 expression in both lines were noticed. This proves the presence of current BAC in medicine at *Ph. impudicus*, the target of which is the DNA. Analyzing the scientific data, it was investigated that BAC *Ph. impudicus* phloretin stops the cell cycle in the G₀ / G₁ phase, induces expression of the proapoptotic proteins of caspase-3, p53, inhibits the expression of the anti-apoptotic protein Bcl-2.

Under the influence of 3 % *Ph. Impudicus* extract cell cycle was blocked in *GC-1 spg* and *GC-2 spd* cell lines in the G₀ / G₁ phase, enhancement of expression of apoptosis markers - caspase-3, p53, inhibition of Bcl-2 was investigated.

Keywords: *Phallus impudicus*, cell cycle, apoptosis, biologically active compounds, spermatocytes, spermatogonia.



ELECTROMAGNETIC RADIATION INFLUENCE ON FOOD QUALITY OF SEEDS AND PRODUCTIVITY OF *NIGELLA SATIVA* L. PLANTS

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Nigella sativa L. is a valuable medicinal plant of the Ranunculaceae family. It is important for Belarus to look for optimal conditions and methods for cultivating *Nigella sativa* plants. Thus it is necessary to use stimulating factors to increase the agro-technical characteristics of plants. For that purpose, we chose the electromagnetic treatment of the millimeter range of low-intensity (EMR) which had proved itself well in a number of vegetable crops both in Belarus and abroad.

The effect of EMR on the morphobiometric parameters, productivity and the oil composition from *Nigella sativa* seeds immediately after exposure (EMR1) and at the end of the vegetative period (EMR2) has been estimated. The physical effects on the seeds of the EMR of the regimes: Regime1 (frequency 53.57–78.33 GHz) with 20 minutes treatment exposure (R1), Regime 2 and Regime 3 (frequency 64.00–66.00 GHz) with processing exposures of 12 minutes (R2.1) and 8 minutes (R2.2) respectively have been selected for study. Seed treatment has been performed at the Institute for Nuclear Problems of the Belarusian State University. Extraction of the oil from the *Nigella sativa* seeds was carried out with hexane in the Soxhlet apparatus for two hours, which corresponded to 6 cycles. Qualitative and quantitative analysis of the oil from the *Nigella sativa* seeds was performed by gas chromatography.

The vegetation period of the *Nigella sativa* in the conditions of the central agro-climatic zone of Belarus is about 145 days. The pre-sowing treatment by EMR contributed to the appearance of more friendly shoots and stimulated growth processes especially at the beginning of the juvenile period. This was reflected on the productivity elements formation of this culture and in the control, it was 39.59 g/m² and depending on the regime of exposure was from 9.32 to 45.24 g/m². According to the obtained data, unsaturated fatty acids predominated in the *Nigella sativa* seeds' oil and their content hesitated depending on the year of cultivation and the EMR regime. The main component was linoleic acid (56.4–61.9 %) and then was the content of oleic (13.4–16.8 %), eicosadienoic (2.8–3.6 %) and linolenic (0,36–0.68 %) acid. The change in the quantitative composition of fatty acids as a result of pre-sowing EMR exposure has been noted. Changes in the composition of fatty acids of *Nigella sativa* seeds' oil after EMR1 has been associated with a decrease in the amount of linolenic and arachidonic acids. In the case of EMR2, a significant decrease in the amount of stearic acid and rise of unsaturated fatty acids content has been noted. It was revealed that the EMR in the *Nigella sativa* seeds' oil had reduced the amount of timokhinone in all studied cases. At the same time, the treatment by P2.1 resulted in the lowest content of timochinone in the oil. This dependence persisted in different years of research.

So EMR influences on the morphobiometric indicators and the composition of the active metabolites of *Nigella sativa* seeds has been established.

Keywords: electromagnetic radiation of microwave range, *Nigella sativa* L., fatty acids, thymoquinone.

Acknowledgment

The authors are grateful to Dr. Valentina N. Rodionova, Institute for Nuclear Problems of the Belarusian State University, for seed treatment and P. Shabunya, Insitute of Bioorganic Chemistry.

LEGISLATIVE AND REGULATORY FOOD SAFETY IN UKRAINE

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Ensuring the safety and quality of products is an important component of protecting the health of consumers in any country. Legislation on the safety and quality of food products in the European Union (EU) member states is now recognized as one of the best and most effective in the world.

The EU-Ukraine Association Agreement, signed in 2014, clearly sets out the obligations of our state to harmonize national legislation with the requirements of the EU by 2021. These obligations also apply to the requirements for quality, food safety, and the state control system for compliance with food safety legislation that is produced and put into circulation in the territory of Ukraine.

A fairly large part of the Association Agreement with the EU Chapter IV (Sanitary and Phytosanitary Measures) of Section IV 'Trade and Trade-related Issues' is devoted to the safety of food products and sanitary and phytosanitary measures. National food and consumer market operators are waiting for the adoption of a number of bills that will cover the entire scope of the quality and safety of food products. Ukraine should implement more than 250 EU acts in national legislation, which should establish a common framework of compliance with national food, feed, and food safety standards and other EU sanitary and phytosanitary measures and legislation. In addition, the Cabinet of Ministers of Ukraine, on October 25, 2017, approved Resolution No. 1106 of the Plan of Measures for the Implementation of the Association Agreement between Ukraine, on the one hand, and the European Union, the European Atomic Energy Community and their Member States, on the coordination of the European and Euro-Atlantic integration Implementation of the Action Plan to ensure an uninterrupted process of fulfilling Ukraine's commitments throughout the period of the Agreement, availability of information on its implementation, clarity of implementation mechanisms and interference with unfulfilled measures. In the Action Plan, paragraphs 216 to 445 relate to the implementation of the Agreement on the Activities of Sanitary and Phytosanitary Measures in General and Food Safety.

In accordance with the implementation plan of the Association Agreement in Ukraine by 2017, a number of legislative acts have already been adopted, laying the foundations for reforming the food safety system through the implementation of basic European principles and practices. In particular, the Law of Ukraine 'On Basic Principles and Requirements for the Safety and Quality of Food Products' was adopted. The introduction of innovations involves the introduction in Ukraine of a European concept for product safety and quality management based on a lawn-to-table approach and containing a requirement for traceability (Regulation (EC) No 178/2002). The law sets deadlines for the gradual transition to the application by manufacturers of procedures based on the principles of risk analysis, hazardous factors, and control at critical points of HACCP by 2019.

Effective harmonization of national requirements for quality and safety of food products with the requirements of the EU will promote the introduction of an effective European system of state control of safety and quality of food products.

Keywords: legislative, regulatory, food safety, HACCP, harmonization of national requirements.



TECHNOLOGY OF MAKING PECTINIST FRUIT PASTES

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In Ukraine, there are cities in which the extremely difficult ecological situation and in the lungs of people get a lot of dangerous metals lead, nickel, zinc, cobalt, aluminum, tin, etc., which causes intoxication of the body and provokes the development of cancer.

The necessary minimum of pectin's in the daily diet –2–5 g. Their main function is that passing on the intestinal tract, they adsorb toxic substances that are formed both in the process of digestion and those that came from the outside. It is especially important that they remove radionuclides from the body, as well as side cholesterol.

Works carried out by the Institute of Microbiology and Virology named after D. K. Zabolotny of the National Academy of Sciences of Ukraine showed that pectin products bind ions Zn²⁺, Co²⁺, in acidic media Pb²⁺, and in weakly acidic Nb³⁺, Ce³⁺, Al³⁺.

Sampling was carried out according to DSTU ISO 874-2002 "Fruits and vegetables are fresh. Sampling ». The content of dry substances was determined according to DSTU ISO 751: 2004. The temperature of the hydrolysis process was controlled according to DSTU ISO 386: 2018 (ISO 386: 1977, IDT). The acidity of the medium was determined by pH meter according to DSTU 8449: 2015 "Canned food products. Methods for determination of organoleptic parameters. "Determination of pectin content was carried out using titer method. The gel-forming ability of pectineous pastes was determined on a Sosnowski device.

Pumpkins were chosen for the research object. In experiments, the method of obtaining pectin-containing pastes due to the hydrolysis of plant material with lactic acid and cottage cheese, which are both preservatives, was realized.

It is established that at high concentrations of lactic acid a very sour product and destructive pectin are formed. The optimal concentration of acid for a delicious pectin paste is a 1.5 % solution of 39 % – a percentage of lactic acid.

The best consistency of the paste and its golden-apricot color was formed at GM 1:16 and the optimum temperature of hydrolysis 70–80 °C.

The process of hydrolysis of raw materials was combined with the processes of concentration of the product under vacuum, which gave the opportunity to get paste containing pectin 7–10 % and saves in it all the multivitamins and other nutrients.

The research of pastes in the 'Ukrainian Research Institute of Nutrition, Biotechnology and Pharmacy' on physicochemical and microbiological indicators, as well as on safety indicators showed that the products meet the requirements of the MBT No. 5061-89 and can be used for treatment and prophylactic nutrition of the population.

The developed technology and line for the production of pectin-containing pastures from plant raw materials has practical value for medical and prophylactic nutrition of the population and is attractive for investment.

Keywords: pectin, thermal process, hydrolysis, vacuum vehicle, radio is nuclides.

ORGANIC AGRICULTURE IN THE WORLD AND AZERBAIJAN

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Organic farming is an alternative to intensive agro-farming based on the broad use of agro-resources (agro-technical, chemical fertilizers, pesticides). Such agricultural methods are called 'organic', 'biological' or 'ecologically clean'. In most of the relevant standards, these concepts are regarded as synonyms. The purpose of the research is to study the various positive aspects of organic agriculture and to determine that their foundations are based on fundamental principles.

The objects of organic farming systems rely on methods of biological combating with maximum crop rotation, plant residues, livestock, beans, green manure, farm organic waste and pests to maintain soil fertility and seedlings, feed crops, control insects, weeds and other damaging species. Synthetic (chemical) fertilizers, sewage sludge, irradiation and genetic engineering methods in organic farming are not permitted (www.usda.gov.us). Codex Alimentarius prefers an ecosystem approach. Here, organic agriculture is understood as a complete production management system that promotes and promotes healthy agro-ecosystems, including biodiversity, biological cycles, and soil biological activities'. He emphasizes 'the use of appropriate management practices instead of farms and the application of local systems to take account of regional differences' (www.codexalimentarius.org).

According to the results of the study, although there are different definitions that highlight various positive aspects of organic farming, all are based on the same basic principles. The US Department of Agriculture (USDA) National Organic Program identifies organic production by using or restricting methods, such as 'production system', whether it is important to avoid or avoid the use of synthetic fertilizers, pesticides, regulators and livestock feed additives to the extent possible. Organic production in Azerbaijan has been started about 10 years ago. According to the data for 2015, the land allocated for the cultivation of organic plants was 0.8 % of the total agricultural land (Viller et al., 2017). According to Viller and Lernun's report (2016) and according to the data of 2014, the number of farms was 297 and the number of workers was 34. In 2016, the total area of organic areas in Azerbaijan was 24.391 ha, of which 23.331 hectares were cultivated, 937 hectares of wild fruits, nuts, berries, as well as for medicinal and aromatic plants, and 123 hectares – forests organized. Although organic grains are grown in organic areas, organic fruits are more common in total production. During the transitional period, fruit gardens will also contribute to the further development of Azerbaijan. The only animal breeding product produced in Azerbaijan is that according to the data for 2014, 932 bee breeds were registered in the country. The volume of land approved as organic in 2014–2015 increased by 14.299 hectares.

On the other hand, the transition from small to resource-oriented agriculture to organic agriculture can help farmers to fight pests and increase soil fertility. The transition to massive and successful, the only problem is that the sales prices of farmers can be reduced as the volume of organic products entering the market is high.

Keywords: organic farming, organic production, chemical fertilizers, soil fertility, biological cycles.



EFFECT OF CHANGES IN POLYUNSATURATED FATTY ACIDS ON THE QUALITY OF WALNUT OIL

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The walnut oil obtained by the cold pressing of *Juglans regia* L. kernels is a food of high quality because of dominated content of polyunsaturated essential fatty acids: linolenic, linoleic, docosahexaenoic, eicosapentaenoic (ω -6, ω -3). The quality and shelf life of walnut oil depend on several factors, among which the physicochemical changes in polyunsaturated fatty acids play an important role. The processes of polyunsaturated fatty acids auto-oxidation under the action of enzymes, atmospheric oxygen and light have a strong influence on the quality decreasing of walnut oil.

The purpose of this investigation was to study the dynamics and kinetics of the polyunsaturated fatty acid oxidation processes; and analysis of the formation of primary and secondary oxidation compounds. Experimental researches were carried out during 2014–2018 years using walnuts of Cogalniceanu variety, harvested in Calarasi area (Republic of Moldova). Walnut oil was obtained by cold pressing of the walnut kernels and oil yields were determined. The analysis of walnut lipids, reactions kinetic of polyunsaturated fatty acids oxidation, and accumulation of primary and secondary oxidation compounds was studied. Changes in physicochemical and sensory quality of the walnut oil were determined. Freshly obtained walnut oil had the followed indexes of quality: acidity – 0.38 ± 0.07 mg KOH/g; iodine value – 148.0 ± 0.6 g per 100 g of lipids; saponification index – 188.0 ± 1.3 mg KOH/g; water content – 0.1 %. The content of polyunsaturated fatty acids (ω -6, ω -3) in walnut oil ranged from 8.0 to 13.0 % of total fatty acids. During storage, the walnut oil changed permanently with losses of nutritional quality. The reaction of hydroperoxides formation as the primary oxidation compounds had zero order, but the rate of reaction was variable. Take into account that the molecular mechanism of lipid oxidation-reduction reactions is complex; the kinetic model of the lipid oxidation process was developed.

During storage, the variability of constant (K , days⁻¹) of reaction rate for hydroperoxides formation was evaluated depending on temperature and storage duration. At the initial stage of storage, an increase in storage temperature from 3 to 60 °C led to a rise in reaction rate constant by 17.8–35.0 times (from 0.052 to 1.821 days⁻¹). At the second stage, the process of hydroperoxides decomposition began, but the rate of this process was 2.15 times less than the reaction of their formation. After 180 days of storage, the concentrations of hydroperoxides stabilized at values of 1.7–3.0 μ mol/kg. It was shown that the changes in the acidity of walnut oil were significantly slower and ranged from 0.38 to 0.53 mg KOH/g.

Keywords: walnut oil, polyunsaturated fatty acid, hydroperoxides, acidity.

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BIOCHEMICAL COMPOSITION OF BEE POLLEN AND INFLORESCENCES OF *BRASSICA NAPUS* L. VAR. *NAPUS*

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Genus of *Brassica* L. belongs to *Brassicaceae* Burnett, which is the most important group of plants due to their economic, nutritional, medicinal, pharmaceutical value. Plants of *Brassica* used as food and forage crops in the worldwide. *Brassica napus* L. is used in the production of oil and livestock feed. It is wide cultivated crop due to high content of oil in the seeds (up to 40 %). Study of bee pollen properties interesting because it is natural product, which contain biologically active compounds such as protein, amino acids, especially essential. Nutritional value of bee pollen protein is important parameter for honeybees and depends on concentration of amino acids.

Plant material of this study was *Brassica napus* L. var. *napus* harvested at the period of flowering. Total content of ash and protein determined according to EN method (ČSN EN 12145, 1997). Content of lipids detected by ISO method (ISO 659: 1998), carotenoids by ČSN 560053, 1986, ascorbic acid and fatty acids content by HPLC method, amino acids content by ion-exchange liquid chromatography.

Results demonstrated that inflorescences and bee pollen of *B. napus* var. *napus* accumulated dry matter 10.13 and 70.10 %, protein 21.05 and 23.60 %, ash 9.92 and 2.16 %, lipids 4.78 and 4.39 %, β -carotene 7.8 and 4.2 mg/kg, respectively. Content of saturated fatty acids (g/100 g) in inflorescences and bee pollen was 37.80 and 22.70 of fat, mono unsaturated fatty acids 4.60 and 5.20 of fat, polyunsaturated fatty acids 21.70 and 53.50 of fat, respectively. Composition of amino acids (g/kg) in inflorescences and bee pollen of *B. napus* var. *napus* was following: alanine 6.4 and 9.8, arginine 5.7 and 8.8, glycine 8.8 and 10.1, histidine 5.4 and 7.3, isoleucine 4.5 and 7.5, glutamic acid 35.5 and 22.3, leucine 8.2 and 13.9, lysine 8.9 and 14.3, phenylalanine 5.7 and 9.2, proline < 0.2 and 16.2, threonine 0.4 and 1.5, tyrosine 4.3 and 5.5, valine < 0.2 and 11.1, asparagine 18.4 and 18.8, cystine 3.8 and 3.6, methionine 2.7 and 5.9, tryptophan 1.9 and 3.3, respectively. Qualitative content of lipids showed presence of complex of fatty acids. Among them linolenic acid had a highest content in bee pollen (40.73 g/100 g of fat). In bee pollen also found palmitic acid (18.84 g/100 g), linoleic acid (12.80 g/100 g), oleic acid (3.97 g/100 g), etc. Other investigated fatty acids of bee pollen found in less concentrations. Inflorescences characterized by presence of following fatty acids: palmitic (15.06 g/100 g), linolenic (11.37 g/100 g), linoleic (10.36 g/100 g), lauric (6.31 g/100 g), capric (5.72 g/100 g), myristic (4.10 g/100 g), oleic (3.41 g/100 g), stearic (3.35 g/100 g), etc. Other investigated fatty acids of inflorescences had less concentrations.

Thus, inflorescences and bee pollen of *B. napus* var. *napus* are valuable source of nutrients with high content of dry matter, ash, protein, fatty acids, etc. Bee pollen of this plant had higher level of amino acids comparing with inflorescences besides glutamic acid and cystine. It is rich source of fatty acids. Obtained data can be used for farther biochemical and pharmacological investigations.

Keywords: *Brassica napus* L. var. *napus*, inflorescences, bee pollen, biochemical composition

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EVALUATION OF THE NEW UKRAINIAN CULTIVARS OF CORNELIAN CHERRY (*CORNUS MAS L.*) FRUITS

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Cornelian cherry (*Cornus mas L.*) is a species native to various European and southwest Asian countries. Its fruits are edible and can be consumed raw or in the form of jams, beverages, pickles, and many other preserves. Additionally, they have been used as traditional medicine. Although its fruits are proved to be the source of numerous beneficial components, such as natural antioxidants and pigments, this species belongs to forgotten plants. Cornelian cherry fruits contain many radical-scavenging components that provide protection against harmful free-radicals and can act against gastrointestinal disorders, heart diseases or diabetes.

The aim of this study was to evaluate the basic chemical composition and bioactive potential of three new Ukrainian cultivars of Cornelian cherry fruits: Jubilejnyj Klymenko, Pervenets, and Sulija. For this purpose, they were compared with selected registered Ukrainian (Kostia, Ugolok) and Polish (Bolestraszycki, Szafer) cultivars. All fruits used for the study were collected in 2018. Registered Ukrainian and Polish cultivars were provided by Arboretum in Bolestraszyce (Poland) and new Ukrainian cultivars by Gryshko National Botanical Garden in Kyiv (Ukraine).

The basic chemical composition, the content of polyphenols, anthocyanins, and iridoids of each cultivar was compared. Content of vitamin C was determined by the 2,6-dichloroindophenol titrimetric method. Total phenolic content (TPC) was evaluated using the Folin-Ciocalteu reagent assay. Antioxidant activity was measured using two different spectrophotometric methods, DPPH (2,2-diphenyl-1-picrylhydrazyl) and ABTS (2,2-azino-bis-3-ethylbenzothiazoline-6-sulfonic acid).

The content of vitamin C varied from 31.99 to 63.18 mg/100 g. The results of antioxidant activity ($\mu\text{mol Trolox}/100 \text{ g}$) determined by the DPPH method varied from 13.80 to 31.85 and obtained by the ABTS assay varied from 21.35 to 37.57. The results of TPC (mg gallic acid/100 g) varied from 168.79 to 445.71. This study determined the variability of all chemical characteristics of fruits and showed that the new Ukrainian cultivars composition can be compared with those previously registered. High vitamin C content, compared to registered varieties, was determined for Jubilejnyj Klymenko (53.02 mg/100 g) and high antioxidant activity (ABTS) of 30.66 and 30.31 $\mu\text{mol Trolox}/100 \text{ g}$ respectively for Pervenets and Sulija.

The importance of collection, identification, and evaluation of genetic resources of plants is significant in terms of designing their application. Thus, the results of the present study can be helpful to select the most promising sources of bioactive compounds among this species and support the antioxidant potential of the new Ukrainian cultivars of cornelian cherry fruits.

Keywords: Cornelian cherry, chemical composition, polyphenols, iridoids, antioxidant activity.



SPECIES OF THE GENUS *LYCIUM* L. IN THE COLLECTION OF M.M. GRYSHKO NATIONAL BOTANICAL GARDEN OF NAS OF UKRAINE

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The genus *Lycium* L. has about 96 species distributed in the temperate and subtropical zones of both hemispheres. Fruits of about 32 of them are used in food in particular in Chinese traditional medicine. Recent studies confirm the healing properties of these berries. They are also rich in carotenoids, vitamin C, specific polysaccharides, betaine, quercetin, and selenium. Fruits of *L. barbarum* L. and *L. chinense* Mill. known as goji, sometimes happen anthocyanin-rich black goji – *L. ruthenicum* Murr. In Ukraine, species of this genus have not been sufficiently studied. In 2015, we began to create a collection and explore the goji in M.M. Gryshko National Botanical Garden of NAS of Ukraine (Kyiv).

The purpose of the study was to describe the gene pool of plants of the genus *Lycium*. The results obtained will help to investigate the biology, ecology of species and evaluate the prospects of cultivating goji culture in Ukraine.

The objects that have been studied are species of the genus *Lycium* of a collection of plants growing in M.M. Gryshko National Botanical Garden (NBG) from seeds, cuttings or seedlings obtained from China, France, Slovak Republic and other Botanical Gardens of Ukraine and gardeners. Four species were investigated in an experimental study 2016–2019, including 10 cultivars and 6 varieties. The biometric parameters of plants were determined: plant habitus and their annual growth, parameters of vegetative and generative organs, the passage of phenological phases. The study used one plant per genotype.

The collection includes three East Asian species: *L. barbarum* and 2 genotypes, *L. chinense* and 3 genotypes and 5 cultivars (Big Lifeberry, Sweet Lifeberry, Q1, Delikat, Amber Sweet), *L. truncatum* Wang. and 5 cultivars (N1 Lifeberry, New Big, Princess Tao, Korean Big, Super Sweet). And also one species has a Mediterranean origin – *L. europaeum* L. All plants bloom, bind fruits and form viable seeds except *L. europaeum*. The beginning of vegetation in all species occurs in the last decade of March to the first decade of April. *L. barbarum* the first begins to bloom from late April, mass flowering in all species lasts from June to early September. Fruits reach a month after flowering. *L. barbarum* and *L. truncatum* it bears fruit from late June to early October, *L. chinense* from August to October. Variety *L. chinense* LC02 reach the fruits in October at the latest.

The morphological features of the cultivars N1 Lifeberry, New Big, Princess Tao, Korean Big, Super Sweet were found to originate from *L. truncatum*. The Amber Sweet cultivar has the characteristics of *L. chinense* and is not *L. barbarum* as claimed by the originator. Collection of *Lycium* spp. in NBG is the basis for the study of representatives of species and their varieties, selection of promising genotypes and cultivation in Ukraine.

Keywords: goji, *Lycium*, fruits, new crop, collection.



POSTER PRESENTATIONS

SENSORY ANALYSIS OF BEE BREAD WITH DIFFERENT PRODUCTION TECHNOLOGIES

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Compared to other beekeeping products that are not as fastidious to storage conditions, the quality and nutritional properties of bee bread depend on the conditions of obtaining, storage of bee bread combs and the technology of keeping of this product.

Therefore, the purpose of the work was to evaluate the bee bread obtained using different technologies for organoleptic parameters. For comparison, the following technologies were chosen: bee bread in combs without removing with drying (AA); classic with manual removal of bee bread (AB1); classical with freezing of honeycombs and shredding of wax and bee bread mass (AB2); industrial technology using artificial combs (AV). The research was conducted during the years 2015–2018. In experiments, bee families of the Ukrainian breed from the apiaries in four regions were involved in accordance with the requirements of DSTU 7074: 2009 'Bee bread. Specifications'.

The AA bee bread had no signs of mildew or acidification, was characterized by a pleasant aroma of freshly baked bread that was excessively mixed with the smell of wax and propolis. The taste of bee bread was consistent with the product, without any foreign flavors. The bee bread did not keep the shape of the granules, split into smaller particles, often in the colors of the pollen. This may indicate an uneven gluing density of pollen grains not only in the condition of the bee pollen but also in the bee bread pellet. The AB1 bee bread had different size of granules, color, and shape, some granules had punctures, indicating the removal of the bee bread from the honeycomb with a needle-like rod. A large proportion of granules of small size or their splits can be caused by the method of extraction.

The AB2 bee bread had unsatisfactory organoleptic properties. The bee bread granules were completely destroyed, larger bits resembled plaques of different colors. The fragrance was much weaker, the taste was less distinct, the fiber became more noticeable (the sense of chewing sawdust), the mass became brittle and sticky. The quality of the bee bread, both visually and tastefully, has deteriorated significantly. It was also visually seen that the bee bread contains excessive amounts of moisture. Compared to the control samples from this apiary, the bee bread aroma was much weaker, the taste was sourer. The bee bread granules of AV sample were densely formed, had a clearly distinct hexagonal shape with a small fraction of smaller size in the total mass. There were no broken granules.

Keywords: beebread, granules, sensory analysis, quality.

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**RESEARCH ON RADIOACTIVITY OF UKRAINIAN HONEYS****Leonora Adamchuk¹, Ihor Kharchenko¹, Rostyslav Komar¹,
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Today, among the important indicators of food safety is the level of its contamination with radionuclides. Technogenic accidents on nuclear facilities (Three Mile Island NPP in USA, Fukushima Daiichi NPP in Japan, Chernobyl NPP in Ukraine) have led to the uncontrolled entry of radionuclides into the environment. As a result, the content of isotopes that are β -radionuclides has grown by thousands of times (uatom.org/index.php/beta-beta).

It is known that when sources of β -radiation reach the body with food, water, and air, the internal irradiation of the organism occurs, which can lead to severe radiation damage (Kutovyi et al., 2009). This is especially true for foods that are not exposed to any temperature treatments that could reduce the level of radioactive contamination. These products include the product of plant and animal origin – honey. The minimum level of radioactive contamination that needs attention is 4000 Bq/kg. Iodine-131 is a β -emitter that is absorbed by the thyroid gland; Cesium-137 – β -emitter, accumulates in lymph nodes and liver; Plutonium-239 accumulates in the lungs and reproductive organs. It is known that penetrating radiation causes ionization of atoms and molecules of an organism and leads to a violation of vital functions of individual organs, bone marrow defects, and as a consequence – the development of radiation sickness.

The purpose of our research was to determine the total activity of β -radionuclides in honey produced in different regions of Ukraine. Tests of total β activity were performed on the beta-radiometer “KPK1-01A” using the ⁴⁰K isotope.

As a result of the research, 66 samples of honey were analyzed from Odesa, Cherkasy, Zaporizhzhya, Zakarpattia, Kherson, Vinnytsia, Sichaslavska, Kyiv, Ivano-Frankivsk, Ternopil, Kharkiv, Khmelnytsky, Kirovograd, Lviv, Mykolayiv, Chernihiv, Poltava regions.

It was established that the total activity of β -radionuclides in honey obtained in different regions of Ukraine did not exceed the allowable norms for food products and ranged from 1 to 17 Bq/kg. At the same time, in compliance with the requirements of the state hygiene regulations (2006), the allowable levels of ¹³⁷Cs and ⁹⁰Sr of radionuclide content in honey and beekeeping products should not exceed 200 Bq/kg and 50 Bq/kg, respectively.

Keywords: β -radiation, radioactivity, Ukrainian honey.

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**DIVERSITY OF POLLEN GRAINS OF *TILIA* GENUS IN UKRAINIAN HONEYS****Leonora Adamchuk¹, Oleksandr Shynder², Jana Šimková³**¹National University of Life and Environmental Sciences of Ukraine,
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One of the most valuable varieties of Ukrainian honey is linden, known for its medicinal properties and organoleptic commodity qualities (taste, aroma). However, exporters often face the problem of identifying pollen grains of certain species of *Tilia* spp. in honey, which makes it impossible to position them as a varietal. That is why studying the morphological features of pollen grains of the species of lindens growing on the territory of our state for the purpose of further their recognition in honey has a significant scientific and practical significance. Features of the structure and surface of pollen grains of the *Tilia* genus were studied by various scientists using scanning electronic microscopy (Chambers & Godwin, 1961; 1971; Andrew, 1971; Stockmarr, 1974). However, profound scientific research, in the vast majority, concerned two types – *T. cordata* Mill. and *T. platyphyllos* Scop. In the modern database of pollen grains for identification of them there are only four species of lindens – *T. × euchlora* K. Koch, *T. cordata*, *T. platyphyllos* and *T. tomentosa* Moench (www.palдат.org); and only two of them (*T. euchlora* and *T. tomentosa*) have an image of a pollen under a light microscope, which is suitable for identification of the species in honey. At the same time, there are other resources for identification of linden species. For example, Science and Plants for Schools (SAPS) (www.saps.org.uk), which offers images of three species of lindens – *T. platyphyllus*, *T. × euchlora*, and *T. × europea*. The Pollen-Wiki resource also offers images of only three species of linden – *T. Henryana* Szyszyl., *T. platyphyllos*, and *T. cordata*. Atlas of pollen grains of Russian authors, which is widely used to identify the botanical origin of honey from Eastern Europe and Asia, has identifiers for only two species of lindens – *T. begoniifolia* Steven and *T. cordata*.

In the flora of Ukraine, there are 5 native species of the *Tilia* genus and 2 hybridogenic species. In addition, in plantations and parks throughout the territory of Ukraine, it is cultivated more than 10 introduced species of the genus. This causes a sharp need to study the morphology of their pollen grains for further identification of honey. For a separate direction of experimental work, we have selected to study the morphological features of pollen grains of various forms of the hybridogenic species *T. × europea* (*T. cordata* × *T. platyphyllos*), which is one of the earliest flowering species, is widely distributed in parks and other artificial plantations and has high seed reproduction rates.

Keywords: *Tilia*, pollen grain, Ukrainian honey, linden honey.

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ESTIMATION OF ANTHROPOGENIC LOADING OF THE HUMAN BODY BY CHEMICAL ELEMENTS ACCORDING TO THE DATA OF ECOLOGICAL AND HYGIENIC MONITORING IN UKRAINE

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In the modern urban environment, the effect of chemical elements (as aluminium, silver, manganese, chromium and others) represents a pressing issue in the context of both anthropogenic burden and occupational health impact, so the examination of their action can provide support to the justification of regional reference values which eventually will ensure the implementation of efficient and effective hygienic measures. Thus, the purpose of this research was to reveal the profile of the specific impact of metals as low-dose factors on the endocrine system and to build the basis for justification of their optimal levels in biological media, to improve the methodological approaches to pathogenesis, diagnostics and assessment of risk.

Samples of soil (40 samples), air (48 samples), drinking water (182 samples), food (246 samples) and biosubstrates (hair, whole blood, serum, saliva and urine- all 100 samples) on the content of Al, Ag, As, Cd, Cr, Mn, Pb, Ca, Mg, Fe, Se, Ni, Cu, and Zn) were prepared according to the validated and approved method on the instrument of optical emission-spectrometry with inductively coupled plasma (OES-ICP) on the device Optima 2100 DV from Perkin-Elmer (USA).

Complex environmental and hygienic studies revealed the consistent toxicant pattern with different trends in various environmental samples. For instance, a gradual increase in metal level is observed in soil (43 % for Al and 2.45 – fold for Zn), in air (9-fold for Al, 5-fold for Ni, 4-fold for Mg, 6-fold for Mn, 30 % for Zn), in drinking water (tap water: 1.6 TLV (Ca), 1.2 TLV (Mg); artesian water: 1.45 TLV (Mn), 1.2 TLV (Fe), 1.1 TLV (Pb) and in food products (vegetables and breads: 1.02–2.90 TLV (Al and Cr); meat products: 3.0 TLV (Cr), milk products and breads: 1.4-1.6 TLV (Pb)). At the same time, a certain deficit of essential elements (Se, Ca, Mg, Cu, Zn) was detected in drinking water and food products. It was demonstrated that Al, Cd, Cr, Mn, and Zn levels in various environmental compartments make these metals priority exposition markers for future researches.

The obtained results allowed to justify metal concentrations in biological media for Ag, Al, Mn, and Cr exposure which met the acceptable level of the health risk according to criteria of endocrine functional changes. It was established that the content of microelements in biological media examined in a number of cases corresponded to their minimum physiological levels (Pb, Zn, Cd, Mg, Se), optimal levels (Mn, Fe, Cu, Ni, Ca) and maximum physiological levels (As and Al). Optimal blood levels are 0.20 mg/l (Al), 0.02 mg/l (Ag), 0.02 mg/l (Cr) and 0.038 mg/l (Mn); and when they are exceeded, the surrounding environment is considered to be an increased risk environment in the context of exposition to these metals.

The conducted research allowed to expand the methodological approaches to the complex hygienic and environmental assessment of the metal effect on the development of endocrine pathology; optimal levels of these metals in human biological media were justified and evaluation of the environment-associated risk of endocrine disorders in man was performed.

Keywords: metals as low-dose factors, reference values, endocrine system, occupational risk.

EXPERIENCE OF RATIONAL VITAMIN SUPPLEMENTS INTAKE IN THE OBSTETRICIAN PRACTICE

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Maintaining a healthy, balanced diet during the pregnancy period is important but additional supplements have been shown to be important as well. Nowadays, in the literature discusses the position that the use of vitamin supplements during pregnancy affects the increase in baby's weight, which leads to macrosomia and related maternal complications during the period of gestation and delivery. The question of the expediency of the appointment of vitamins remains debatable, which determines the relevance and aim of our study. The aim of this study was to evaluate the frequency of fetal macrosomia development, maternal gestational and intrapartum pathology and positive impact in the case of using a complex of vitamins during the period of pregnancy.

On the basis of the Perinatal Center of Kyiv, 95 women, with singleton pregnancy who delivered a healthy babies during a 2019 year were divided into three groups: 1 – women who received vitamins during the entire period of gestation until the moment of delivery and additional iron in case of diagnosed anemia; 2 – women who used a balanced diet and, if necessary, received iron in the diagnosis of anemia and 3 (control) – women who did not take vitamin supplementation with a physiological course of pregnancy and after a childbirth. For preventive purposes to protect the mother and the newborn from the bleeding, in order to form newborn coagulation factors in the liver, the mother and the baby after the birth were given vitamin K1 1.0 intramuscularly. It was analyzed the general women anamnesis, metabolic risk factors, course of pregnancy and delivery and weight of the newborns (more than 4500 grams and less than 4500 grams). The statistical processing of the obtained results was carried out using standard methods of variation statistics.

Among the 95 women who were participated in the study, 27 had fetal macrosomia. The fetal birth weight was significantly higher in the vitamin supplementation group (29 % versus 6.31 %; 5.3 %, $p > 0.05$). Among the complications of the gestational period, patients of the 1st group were significantly more likely, compared with the other two groups of the study, early toxemia, and polyhydramnios were detected ($p > 0.05$) and a significantly higher cases of labor trauma, pathological deliveries and operations – cesarean section (12 % in case of compare with 6 % – in the second group and 7 % – in the control group).

Prolonged intake of vitamin supplementation increases the risk of fetal macrosomia and for the mother – the frequency of induction of labor, pathological labors, injury to the birth canal and operative interventions. It should be clearly taken into account the feasibility of the appointment of vitamins for the entire duration of pregnancy and, if possible, cancellation of their admission after 30 weeks of gestation with replacing their reception with balanced rational nutrition. Vitamin K administration to the women in labor to reduce the development of the hemorrhagic disease of the newborn is still controversial.

Keywords: pregnancy, nutrition, vitamin supplements, fetus, macrosomia, vitamin K.



COLLECTION OF OLD CULTIVARS OF APPLE TREES IN THE DENDROLOGICAL PARK 'OLEXANDRIA' OF THE NAS OF UKRAINE

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Among the collections of fruit and berry cultures, a collection of ancient cultivars of apple trees is important, which as of 2018 includes 143 trees of 61 cultivars of breeding in 13 countries.

The purpose: one of the main parts of scientific work of Dendrological Park 'Olexandria' of the NAS of Ukraine is preservation and restoration of historical park complexes and plantations, including Fruit Gardens.

The purpose of our work is to preserve the gene pool of the cultivars of the genus *Malus* Mill. further distribution and use in the national economy and ornamental horticulture. The object of research was a collection of old cultivars collected in the Dendrological Park 'Olexandria'. The archival, iconographic and descriptive methods were used in our work. The 'Mur' garden was created in the early nineteenth century. The area of the garden is 3.67 hectares. After 1917, fruit trees were gradually removed.

The program for the restoration of the orchard started in 2008, the main direction of which was the creation of a collection of old cultivars of fruit crops. In 2009, on the territory of the 'Mur' garden, the area of 0.3 hectares was laid in a collection plot of historical cultivars, which belong to the selection of the 16th – the first half of the 20th century. The project of renovation works on the landscape area 'Mur' garden was executed according to archival materials of 1858.

The creations of a collection of ancient cultivars for 2008–2013, 61 cultivars were involved in the number of 143 trees grafted on a semi-cartilage substrate of 54–118 cm. The oldest apple cultivar in our collection is Rambur, which was first described in 1535. An honorable place in the collection is occupied by historic cultivars of apple trees from the collection of L.P. Symyrenko and L.M Tolstoy. In order to increase the collection of historical cultivars, two expeditionary studies were carried out in 2009–2010, as a result, the collection increased with 25 cultivars of apple trees.

The largest variety is represented by cultivars of Ukrainian (15) and Russian breeding (11), German breeding is represented by 6 cultivars, English – 6, French – 4, American – 3, Canadian – 2, Dutch, Czech, Estonian, Lithuanian, Hungarian and Belgian breeds are represented by 1 cultivare. 10 cultivars are unknown. By the time of ripening of fruits, autumn cultivars are (46), summer (11), winter (6).

As seen in a well-known example of European landscape gardening – Dendrological Park 'Olexandria' of the NAS of Ukraine, experience, and prospects of renovation work are shown on the historical area of the Fruit Garden 'Mur'. Among the collections of fruit and berry cultures, a collection of ancient cultivars of apple trees is important, which as of 2018 includes 143 trees of 61 cultivars of breeding in 13 countries.

Keywords: Dendrological Park 'Olexandria', *Malus* Mill., apple tree, old cultivars.



INTERNATIONAL COOPERATION IN THE PROGRAM OF CONSERVATION AND USING OF AGROBIODIVERSITY IN THE INTERNATIONAL AGROBIONET NETWORK

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In 2013, the Institute of Biodiversity Conservation and Biosafety at the Slovak University of Agriculture in Nitra in cooperation with Department of Introduction of the M.M. Gryshko National Botanical Garden at the National Academy of Sciences of Ukraine in Kyiv initiated the establishment of International AgroBioNet network. Targets of the international network are declared in the Memorandum with the aim of creating the basic conditions for the implementation of the international research, education and development program 'Agrobiodiversity for the Improvement of Nutrition, Health, and Life Quality'. Networking activities are focused on the development of international cooperation in the use of traditional, forgotten, less-used and less-known plant species giving priorities: promoting of food security, expanding and using plant species for improving the human health, improving the socio-economic rural development, creating the conditions for the multiplication and cultivation of new plant species.

More than 200 experts and over 30 researches from 21 countries have been officially registered in the International network, which has many activities. Regularly organizes International scientific conferences: 2013 and 2014 (Kyiv, Ukraine); 2015 (Nitra, Slovak Republic); 2017 (Novi Sad, Serbia). In addition, organizations in the network have been actively involved as co-organizers in the preparing of 15 National and International conferences in the past period. Collaborating organizations have set up conditions for research stays and for Ph.D. students within the network. Yearly, 15–30 researchers and Ph.D. student graduate research stay from one week to 10 months at the Institute of Biodiversity Conservation and Biosafety and other workplaces. In the previous period, more than 170 participants have been completed the research stay in SAIA, V4, Erasmus and Bilateral Agreements and other programs within the AgroBioNet network. The results of the project and research stay are presented by participants and experts every year in 40–60 scientific publications.

The coordinators of the international AgroBioNet network have created on-line Proceedings of scientific papers entitled 'Agrobiodiversity for the Improvement of Nutrition, Health and Life Quality'. Every year, more than 100 scientific publications are presented in the Proceedings. The international educational (FarmersEduca, BeeEduca) and research projects for use of less-known plant species, invasive species, bee pollen and bee bread, bioregulators and biopesticides, revitalization of traditional agrosystems and knowledge are regularly ensured. More than 30 monographs, 90 specialized lectures, and 70 posters were used by the participants to prepare the results and knowledge from project activities (<https://agrobionet.uniag.sk>).

Keywords: International network AgroBioNet, International cooperation, International conferences, International projects, Research stay.

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CHARACTERIZATION OF THE *PSEUDOMONAS PUTIDA* LIPOPOLYSACCHARIDES, CAUSATIVE AGENTS OF CHESTNUT DISEASES

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At present, much attention is being paid to the search for new natural immunomodulators, including promising lipopolysaccharides (LPS), which are the main components of the outer membrane of gram-negative bacteria. Despite the fact that the LPS of phytopathogenic species of *Pseudomonas* is well-studied today, representatives of *Pseudomonas putida*, isolated from chestnut leaves, causing large-scale destruction of trees, studied very little.

In this regard, the purpose of this work was to investigate the LPS of *Pseudomonas putida*, isolated from the leaves of chestnut in Kyiv. LPS was extracted from dried cells with 45 % aqueous solution of phenol. The amount of carbohydrates was determined by the Dubois method, the content of proteins was analyzed by Lowry method with Folin reagent. Identification of neutral monosaccharides and fatty acids was carried out on an Agilent 6890N/5973 inert chromatography-mass spectrometry system. The antigenic activity of LPS was studied by the method of double immunodiffusion in agar according to Ouchterlony. The study of toxicity (LD₅₀) was performed on healthy white mice, introducing them the various LPS concentrations. The pyrogenic effect of LPS was determined on rabbits weighing 2.5–3.0 kg by thermometry after an introduction on the minimum pyrogenic dose of LPS. It was shown that yielding of *Pseudomonas putida* LPS was 7.5 % of the dry cell mass. When studying the biopolymer composition it is shown that the content of carbohydrates in preparations of LPS was 63.2 %, protein 1.36 %, and 2-keto-3-deoxyoctonic acid, which is always presented in LPS and is a kind of marker of the molecule, found in small amounts to 0.1 %. In PAAG electrophoresis with the coloration of gels by silver salts, it was shown that *P. putida* synthesizes S-type LPS, presented in the form of heterogeneous bands with the formation of "stairs". By the chromato-mass-spectrometric method, it was established that LPS contains saturated and hydroxy acids with a length of the carbon chain from C₁₁ to C₂₀. Hydroxy acids were predominant, the total percentage of which was 45.61%. The length of the chain and the amount of fatty acids in lipid A play an essential role in the manifestation of toxic effects of LPS. It was found that LD₅₀ of *P. putida* LPS for white mice sensitized with D-galactosamine was 29.73 µg/mouse. Compared to LPS of other *Enterobacteriaceae*: *Rahnella aquatilis* (5–6 µg/mouse) *E. coli* 126 (11.25 µg/mouse), the investigated *P. putida* LPS was less toxic. It was also non-pyrogenic: an hour after its introduction there was a decrease of rectal temperature at 0.2 °C. Hypothermia was observed for three hours. When studying the immunochemical properties of LPS, polyclonal O-antiserum was obtained by immunizing rabbits with a boiled *P. putida* cells. The titre in the reaction of ring precipitation was 1:320 000. In the reaction of immunodiffusion in Ouchterlony O-antiserum against to *P. putida* cells gave with homologous LPS only one clear line of precipitation in a concentration of 1 mg/ml, indicating its serological activity.

Since LPS is a major factor in the pathogenicity of gram-negative bacteria, the obtained results can be used in further work to combat chestnut diseases caused by *P. putida*.

Keywords: *Pseudomonas putida*, lipopolysaccharide, lipid A fatty acid composition, toxicity, pyrogenicity, serological activity.

PROTEOLYTIC ACTIVITY OF MICROORGANISMS ISOLATED FROM BEES AND WAX MOTHS

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Various types of bees have physical, physiological, behavioral, and chemical adaptations which in addition to potential relationships with microbes and other organisms (wax moth), may be particularly important for control spoilage of food stores rich in protein, lipid, and carbohydrate content. It is known that *Bacillus* species isolated from provisions of bees produced numerous extracellular enzymes involved in particularly in protein metabolism. Protease activity has been commonly related to several functions, such as protein transport, cellular, and tissue structuring, defense, and degradation/activation of proteins.

Therefore, the aim of this work was to study the ability of microorganisms isolated from bees and wax moths to produce extracellular proteases.

To determine the enzymatic activity bacteria were grown on a liquid medium, the following composition (g/l): KH_2PO_4 – 1.6; $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ – 0.75; $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$ – 0.25; $(\text{NH}_4)_2\text{SO}_4$ – 0.5; maltose – 10.0; gelatin – 10.0; yeast autolysate – 0.15, pH – 6.5–6.7. Micromycetes were grown on Chapek's medium (g/l): NaNO_3 – 2.0; KH_2PO_4 – 1.0; KCl – 0.5; $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ – 0.5; $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ – 0.015; gelatin – 20.0. The total proteolytic activity was carried out as a result of casein hydrolysis. The elastase activity was determined colorimetrically by measuring the change in the color intensity of the solution during enzymatic hydrolysis of elastin-congo red. To establish the collagenase activity the optical density of the solution was measured after the reaction of the collagen cleavage products with the ninhydrin reagent. Fibrinolytic activity was identified after the formation of fibrin cleavage products.

Three fungi and one bacterium were isolated from bees, two fungi and one bacterium from a wax moth, and one fungal and one bacterial culture from a cocoon of a wax moth. Bacteria that were isolated from the samples (bees, wax moth and cocoons of the wax moth) were very similar in character growth and morphological and cultural properties. As a result of screening of 7 isolated microorganisms, only one fungal and one bacterial culture displayed proteolytic activity, which was 0.01 and 0.0167 units/ml, respectively. Elastase activity identified only in one fungal culture was 6.5 (when cultured in a test tube) and 12.3 units/ml (when cultured in a flask). Fibrinolytic activity was 0.25 and 0.69 units/ml for bacterial and fungal cultures, respectively. Collagenase activity was detected for both fungal and bacterial culture (11.4 and 1.5 units/ml, respectively).

Our findings show that the fungal culture produces enzymes with elastolytic, fibrinolytic and collagenolytic activity. In the future, fungal culture with elastolytic activity can be used in bees pest control.

Keywords: proteolytic activity, bees, wax moths.



'PHYTOUNITS' FOR AMELIORATION OF INDOOR AIR ENVIRONMENT WITHIN HEALTH-CARE FACILITIES

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At present, the quality of indoor air in hospitals is an important issue, widely discussed worldwide. The application of phytoremediation approach is one of the successful technique to improve the hospital environment, therefore the objective of this project was to develop compositions ('phytoremediation units' or 'phytounits') from tropical plants to protect patients and healthcare workers against various types of pollution and hospital-acquired infections. On the initial step, the screening of the collection of tropical and subtropical plants of National Botanic Garden (NBG) was performed to identify plants with high potency to absorb the harmful substances from indoor air, e.g. carbon monoxide and dioxide (CO and CO₂), formaldehyde (H₂CO), benzene (C₆H₆), nitrogen oxides (NO and NO₂), particulate matter (PM), because of the adverse health effects they have caused. Based on the long-time experimental investigation carried out at NBG (with SEM, LM, physiological, biochemical, and microbiological methods) it was recognized that more than 100 species of tropical and subtropical plants characterized by the potent capacity to uptake harmful substances from indoor air and to released VOCs active against pathogenic microorganisms, such as *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Escherichia coli*, *Candida albicans* etc.

Taking into account these considerations, we have elaborated the 'phytounits' composed by tropical ornamental plants for improvement of the indoor air environment. Additionally, plant compositions were equipped by LED lamps to provide plants with optimal growth-light spectrum. The experimental samples of 'phytounits' were introduced into different locations inside the 'Center for Innovative Medical Technologies', i.e. in surgical unit and rehabilitation unit.

The screening of antimicrobial activity of 'phytounits' was undertaken in clinical departments of the 'Center for Innovative Medical Technologies'. It was revealed that the number of *Staphylococcus saprophyticus* colonies in air sampled with Krotov's device after two-weeks exposition was reduced by half, supporting the high phytoncide activity of plants against this microorganism, potential causative agent of nosocomial infection in a patient in hospitals. While α - and β - hemolytic streptococci, and *Staphylococcus aureus* have not been found in the sampled air.

Thus, the findings of this project confirmed the therapeutic value of tropical plants in the hospital environment as an effective method for the amelioration of indoor air quality.

Keywords: tropical plants, phytoremediation, "phytounits", pollutants, hospital-acquired infections.

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***SILYBUM MARIANUM* (L.) GAERTN. PLANTS POPULATION AND WEEDS DISTRIBUTION**

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The specific structure of weeds vegetation and their distribution degree in crops depending on *Silybum marianum* (L.) Gaertn. plants population in the conditions of Pridnestrovie is defined.

Silybum marianum is used in medicinal purposes at liver diseases generally that assumes without herbicides use cultivation technology. It is possible to regulate weeds distribution degree by various *Silybum marianum* plants population.

The goal of research – to establish of *Silybum marianum* plants population influence on weeds distribution degree and structure.

Pervenets Pridnestrovya – the cultivar of Pridnestrovian State University Named After T.G. Shevchenko was used as initial material for planting. Researches were conducted on the exercise plot of the Agrarian and Technological Faculty of the Pridnestrovian State University. *Silybum marianum* seeds planting was carried out on April 22, 2018. Shoots appeared late – on May 18, 25 days later after planting due to the lack of moisture. Experimental plot area was 12.5 m² (2.5×5.0 m.). Row-spacing width in all experience options was 30 cm. 12 plants population options were studied in the experience. *Silybum marianum* plants population in 1–11 options was 0.2; 0.4; 0.6; 0.8; 1.0; 1.2; 1.4; 1.6; 1.8; 2.0 mln. seeds/ha.; option 12 – without *Silybum marianum* seeds (control). Weeds accounting in crops was carried out on July 2, 2018, plants age was 45 days. Weeds weight was defined in a wet and air-dry state.

Dicotyledonous weeds were generally noted: *Amaranthus retroflexus* L., *Setaria viridis* (L.) P. Beauv., *Portulaca oleraceae* L., *Aristolochia clematitis* L., *Atriplex patula* L. *Amaranthus retroflexus* and *Portulaca oleraceae* were noted in all experience options. *Amaranthus retroflexus* held the dominant position. Weeds quantity varied from 540 plants/m² in 1 option up to 28 in the 11th option. Weeds wet weight varied from 3293.2 g/m² in 1 option up to 143.6 g/m² in the 11th option at plants population of 2.0 million plants/ha. Air-dry weeds weight varied from 542.9 g/m² in 1 option up to 25.7 g/m² in the 11th option. Weeds quantity and their weight in the first option were above control, in options No. 2-11 – below. The average mass of one wet weed plant varied from 2.6 g in the 7th option up to 13.0 g in the 3rd option. The average mass of a dry weed plant varied from 0.35 g in the 5th option up to 1.7 g in the 3rd option. The smallest weed plants were defined in 4–9 options. The wet weight of one weed plant was 3.2; 3.3; 3.6; 2.6; 3.0; 2.9 g in 4-9 options respectively; dry weight – 0.5; 0.35; 0.47; 0.39; 0.42; 0.39 g.

The results demonstrate a possibility of weeds distribution regulation by various *Silybum marianum* plants population. The regularity was observed – the *Silybum marianum* plants population is higher; the distribution of the weed and weight is less. The established of *Silybum marianum* plants ability to suppress the number and weeds weight can form the basis for green (without herbicides) cultivation technologies application.

Keywords: *Silybum marianum*, plants population, weeds distribution regulation.



THE SAFETY ASSESSMENT OF INNOVATIVE DRUGS OF MICROELEMENTS RECEIVED BY NANOTECHNOLOGY

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Modern nanotechnology offers broad prospects for the production and use of metals-microelements in the new form of nanoparticles. High permeability and bioavailability of metals nanoparticles make them a valuable product for the creation of innovative mineral fertilizers for agricultural plants. However, the lack of knowledge about their possible danger to human health and the environment determines the need for toxicological studies. The aim of this study was to evaluate the toxicity of citrates of metals (Fe, Cu, Zn, Mg) received by nanotechnology on the human cells culture and blood plasma proteins *in vitro*.

The citrates of metals obtained using the nanotechnology method developed by Kaplunencko-Kosinov. The cyto- and genotoxic effects of metals citrates were investigated on the culture of lung cancer cells (line A-549) and normal keratinocytes (line HaCat) using well-known methods MTT-test and micronucleus test. Conformational changes of human blood plasma proteins (albumin, immunoglobulin G) were determined by normal spectrophotometer and MALDI-tof mass spectrometer. The statistical validity of the obtained results was evaluated according to the Student's criterion.

It was found that incubation of cells with high concentrations (2 mg/ml) of metal citrates caused cells death. The highest cytotoxic activity on the cells A-549 and HaCat showed citrates of Cu and Zn. But Fe citrate causing a cytotoxic effect of about 10 times less than Cu citrate. The smallest toxic effect on the cells of both lines was established for Mg citrate. The concentrations of metal citrates (Fe – 0.025 mg/ml, Mg – 1.00 mg/ml, Zn – 0.005 mg/ml, Cu – 0.002 mg/ml) were harmfully influenced the stability of the cells chromosomes. The greatest genotoxic effect was caused by Zn and Cu citrates, they also the most inhibited cell proliferation. Zn, Cu and Mg citrates caused increased frequency of dual-core cells, that affected the structure of the cytoskeleton and spindle division. Under the influence of these metals citrates, the rate of cell division was slowed down (judging by the change in the ratio of the number of mitoses and dual-core cells per 1000 cells). The incubation of human albumin and immunoglobulin with metals citrates *in vitro* caused changes of experimental protein solution optical density and protein masse. These data indicate changes in the structure of proteins, including their denaturation. The major changes in the structure of the proteins caused Fe citrate and the smallest – citrates of Zn and Mg. The obtained results suggest that the cytotoxic and protein denaturing activity of the nanotechnological metals citrates depended on the toxicity of the metal and exposure doses. The *in vitro* test-system such as human cell culture and blood proteins allow for a short period to determine the level of danger and identify potential risk from the receipt of metal citrates into the human organism.

Key words: microelements, nanoparticles, toxicity, cell culture, blood proteins.

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**MORPHOMETRIC CHARACTERISTICS AND GROWING OF
POTENTILLA ERECTA (L.) RAEUSCH.**

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Medicinal plants are one of the main sources of medical and preventive means of modern medicine. In conditions of climate change, anthropogenic impact, special attention should be paid to the study of plants that have medicinal properties, but natural reserves are limited. *Potentilla erecta* (L.) Raeusch. is of great interest as a valuable medicinal raw material. This plant is part of the pharmacopeia of most European countries. Due to the rich set of biologically active substances, the well-known medicinal plant fistula erect can be effective for the treatment of many ailments associated with the digestive tract and liver disease as well as a hemostatic bactericidal agent. *Potentilla erecta* is used as a diuretic, sedative, antiviral, immunostimulant for gastrointestinal and female diseases.

The purpose of this work was to study the natural populations *Potentilla erecta*, the study of morphometric indices of plants and conditions for their cultivation in order to preserve the medicinal plant in the natural environment and the introduction of a pectoral erect in the culture.

The morphometric indices and yield of seeds of plants *Potentilla erecta* in natural populations of Transcarpathia were investigated. We have established that the first association located at an altitude of 150 m above sea level is a typical meadow plot dominated by dominant plants – *Trifolium pretense* L., *Tanacetum vulgare* L., as well as sub-dominant species – *Daucus carota* L., *Achillea millefolium* L.

Studies have shown that the second association covers the foothill meadow, which is located at an altitude of 250 m above sea level and is represented by a stable of different-digestive. The total coverage of the soil by the grass is 75 %.

It was found that the height of the plant, the number of lateral shoots and knots, the length between the knots, leaf width, the number of flowers and the harvest of the seeds of the first meadow populations of the fistula of the erect are much larger than the second foothill. The possibility of growing plants of *Potentilla erecta* planting in the field conditions was investigated. It was discovered that small seeds sprout only in conditions of intense lighting and require surface sowing.

The stimulating effect on the morphometric indices and the formation of the crop of the pectoral pebble seeds reveals the seedling method with simultaneous shading and watering.

In the first year of vegetation, the planting of the pestle of the erect is effective in the conditions of a transparent polyethylene film.

We recommend conducting sprinkler propulsion during periods of prolonged drought. For a successful winter hibernation, it is necessary to cover the plants with a thin layer of snow or straw. At the end of the summer, *Potentilla erecta* plants are planted in open ground to a permanent place. Increasing the number of *Potentilla erecta* in the natural environment contributes to planting and planting.

Keywords: *Potentilla erecta*, natural populations, morphometrics, condition of cultivation.



ISOMERS OF ESSENTIAL OILS COMPONENTS AND THEIR OPTICAL CHARACTERISTICS

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In recent years in the world, a comprehensive study of optical isomers (enantiomers) of organic compounds has been carried out. The main reason for this interest is due to the important role that optical isomers play in the functioning of living systems and manifestations of biological activity. The physicians have proved that differences in the biological effects of optical isomers on the human body are due to different recognition of them at the molecular level. Among the volatile plant substances that make up the smell of plants, there are many examples of these biological manifestations, since odor recognition also occurs at the molecular level.

Optical isomerism plays an exclusive role in the technologies of the processing of essential oils since the enantiomers of one substance usually differ greatly in their flavor tonality and strength. In particular, d (R) – Carvone has a fortifying odor, while l (S) – Carvone – a smell of mint.

In essential oils, one of the forms of enantiomers predominates most often. It is proved that d (R) – limonene predominates in essential oils of orange, lemon, mandarin, lime, grapefruit, bergamot, cumin, dill, fennel, parsley. At the same time, l (S) – limonene is found in essential oils of conifers, fir, stellate anise, peppermint. The value of optical activity may not be large. However, according to this information, you can check the naturalness of essential oils.

It should be noted that so far not all enantiomers of essential oils have been identified, the structure of a number of substances has been sorted out relatively recently, and their characteristics, including aromaticity, even have opposite meanings in the literature.

The subject of research was the optical isomers of Carvone, which was obtained by adapted preparative method from Dill (*Anethum graveolens* L.), Cumin (*Carum carvi* L.) and Mint (*Mentha spicata*) essential oils. We have been established their belonging to “dR – (+)” or “lS – (-)” of the optical series, determined the value of the angle of rotation, and also performed sensory analysis. The maximum isolation and collection of Carvone enantiomers were provided by a high-performance preparative self-produced column.

The composition purity of the selected enantiomers was verified by gas-solid chromatography on a self-made chromatographic column 3500 mm long, 3 mm in diameter, HP – D-mannitol, solid support – W 80–100 mesh chromosorb (1.5–2.0 m).

According to our data, d (R) – Carvone (right-rotating form) is included in the composition of Dill and Cumin, with a specific rotation of the plane of polarization $[\alpha]_D + 62.5 \pm 0.05$; $[\alpha]_A + 61 \pm 0.03$. Essential oil of *Mentha spicata* contains l (S) – carvone (left-rotating form) with a specific rotation of the $[\alpha]_D$ polarization plane – 63.2 ± 0.05 .

The reliably several of the aromatic characteristics of Carvone enantiomers was determined by organoleptic analysis. So: d (R) (+) – Carvone dill, has a spicy aroma of fresh dill, d (R) (+) cumin has a sharp cumin flavor. l (S) – Carvone mint *Mentha spicata* has a mild spicy aroma with a mint shade.

Keywords: essential oils composition, enantiomers, aromatic characteristics.



DEVELOPMENT OF THE COMBINATIONS OF SPICES FOR THE AYURVEDIC DISHES

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Ayurveda is one of the earliest holistic medical systems of human health, which is confirmed by its principles in modern research methods. According to Ayurvedic science, the effect of food on a person is largely determined by their taste – Rasa, and thermal effect – Virya. Food should be diverse, provide a comprehensive taste and meet recommendations for balancing human energy in accordance with its unique constitution (Prakriti). The personal constitution is determined by a unique combination of three doshas – Vata (dry, cold, agile), Pitta (hot, damp, and agile) and Kapha (damp, cold, inert). Reviving and maintaining Prakriti is exactly what opens up the possibilities of the human body as a complex biological system to self-healing and self-rehabilitation. According to Ayurvedic science, the universal component, which allows the purposeful formation of properties of culinary dishes are spices. Spices, although introduced in small quantities, play a prominent role in the formation of taste and aroma and have physiological activity. Ayurvedic science argues that plants, possessing a powerful energy potential, can transmit it to a human. Majority of spices are sharp in taste with slightly bitter and astringent off-flavors. The sharp and bitter taste of spices is caused by the presence of certain alkaloids and aldehydes.

Due to their properties, spices are recommended for balancing Kapha and Vata doshas. Pitta is a hot dosha, in whose diet spices should be used with caution. As Kapha is cold and heavy, for its balancing products with prevailing sharp, bitter, astringent flavours are required. Therefore, the introduction of spices into Kapha dishes virtually has no restrictions. Vata, although having Kapha coldness, is dry, which restricts the use of spices with an overly sharp taste. The objective of scientific research is studying the content of biologically active substances of compositions of spices for Ayurvedic dishes.

Basing on the previously researches, spices compositions for Vata and Kapha doshas have been developed; the composition for Vata dosha includes allspice, dry ginger root, cardamom and trigonella in a ratio of 1:1:0.8:1.2, and the composition for Kapha dosha consisting of anise, carnation, ginger, and black pepper in a ratio of 1:0.8 :1:1.

The total content of phenol compounds was determined using a photoelectric colorimeter KFK-2MP at a wavelength of 640 nm using the Folin-Ciocalteu Reagent. Determination content of tannin, rutin, and catechin was conducted by the mixture titration method with the KMnO₄ solution at a concentration of 0.1 mole/dm³; the content was determined using KFK-2MP at a wavelength of 530 nm.

The total content of phenol compounds (by gallic acid) in the composition of spices for Vata constituted 223.4±11mg/100 g; for Kapha – 193.4±10 mg/100 g. The content of phenol compounds with P-vitaminic activity was respectively 2.2±0.1 and 2.5±0.1 mg/100 g. The quantitative content of tannin in the composition for Vata constituted 1.5±0.05 mg/100 g, and in the composition for Kapha 1.4±0.07 mg/100 g.

Due to the content of phenolic compounds, including those with P-vitamin activity, the spice compositions will exhibit antioxidant activity, and their use in Ayurvedic recipes will not only provide a variety of taste sensations during each meal but also provide physiological activity, stimulating digestion and creating the conditions for the consumption of nutrients.

Keywords: Ayurveda, Ayurvedic nutrition, spices, biologically active substances.



MORPHOMETRIC LEAF VARIATION OF VARIOUS CULTIVARS CRABAPPLE

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The study of intraspecific variability has both scientific and theoretical and practical significance. M.I. Vavilov (1987) attached great importance to the study of intraspecific variability for the knowledge of the species as a system.

The structure of the leaf blade, the size, the features of the placement of leaves on the plant, their morphological parameters, and morphometric indicators are important features both for identifying the cultivar and for further breeding, especially if they are related to the decorative properties of plants (Goncharovska et al., 2018).

This study was carried out in order to determine the leaf characteristics of some 14 crabapple genotypes in the M.M. Gryshko National Botanical Garden (Kyiv, Ukraine) and also to determine whether the leaf morphometric characteristics could be used for differentiation of genotypes.

The collection of leaves of the objects of the study was carried out in the summer periods from the middle part of the annual plant escape of the mature stage of the generative period. It was selected from the tree of each cultivar 30 leaves from the four sides of crown. The total number of selected leaves was 1680. For each leaf, five characteristics were measured. In this study, leaf length in mm; leaf width in mm; petiole length in mm; petiole width in mm; petiole thickness in mm. Due to the fact that the apple tree has highly prone to hybridization with closely related species of apple trees, selected plant specimens with pronounced morphological species characteristics.

Morphometric parameters were as follows: leaf length from 61.20 (Van Ezeltin) to 84.32 (Golden Hornet) mm, leaf width from 28.1 (Van Ezeltin) to 48.62 (Pink plakucha) mm, petiole length from 12.98 (White Jet) to 35.21 (King Beauty) mm, petiole width from 0.48 (King Beauty) to 1.3 (Royalty) mm, petiole thickness from 0.57 (King Beauty) to 1.41 (Butterbell) mm. The shape indexes of leaves were found ranging from 1.58 (Van Ezeltin) to 2.17 (Everest). Analysis of the coefficient of variation (CV) showed high variability in morphometric characteristics between *Malus baccata* samples.

Data showed that the petiole width and petiole thickness is the most variable signs (from 10.01 to 26.84 and from 6.52 to 35.91 %). Other studied characteristics have an average level of variability.

According to the morphological parameters of the crabapples leaf blade, those that are important in the further selection process were identified. Having these data can pre-select the source material for the parameters that would like to receive in the future hybrid genotypes.

Keywords: Crabapple, cultivar, leaf, morphometric parameters.

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EVALUATION OF *LONICERA CAERULEA* L. GENOTYPES BASED ON MORPHOLOGICAL CHARACTERISTICS OF FRUITS GERmplasm COLLECTION

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The genus *Lonicera* L. (Caprifoliaceae) includes about 200 species, growing in temperate Holarctic. *Lonicera caerulea* L. s.l. is widely cultivated nowadays as an edible plant. This is very polymorphic species and is regarded by some authors as a complex of microspecies or geographical races, including *L. altaica* Pall., *L. pallasii* Ledeb., *L. xsubarctica* Pojark., *L. edulis* Turcz. ex Freyn, *L. stenantha* Pojark., *L. buschiorum* Pojark., *L. baltica* Pojark., *L. turczaninowii* Pojark., *L. kamtschatica* (Sevast.) Pojark. and *L. iliensis* Pojark.

Lonicera caerulea is valued for ultra-early fruit ripening, as well as a high content of biologically active compounds with antioxidant, immunomodulating, antibacterial, antiviral, antifungal, antiallergic properties. It is used in medicine, cosmetic and food industry.

The aim of this study was to determine the variability of morphometric characters of fruits of *L. caerulea*. Reaction norm of fruit's characters is very high, this was the base for the creation of many cultivars in the Russian Federation. The results obtained in M.M. Gryshko National Botanical Garden of NAS of Ukraine (NBG) will help us to select the most promising samples for further breeding work. Plants of *L. caerulea* of seed's origin growing in Forest-Steppe of Ukraine in NBG were the objects of the research. There were 26 genotypes tested in an experimental study in 2017–2018. Pomological characteristics were made on a total of 30 fruits per genotypes. The following measurements were taken: fruit weight, in g, fruit length, in mm, fruit diameter, in mm.

Our collection includes more than 40 genotypes of seed's origin from European Russia, Kuril, and Canada. The differences in weight, shape, size, the color of fruits and the degree of the wax coating were noted. Mature fruits are dark blue, nearly black in color. The shape of the fruits may be ovate, narrowly oblong, broadly oblong, obovate, campanulate; the shape of the calyx end is rounded, truncate, acute; The morphometric parameters were following: fruit weight from 0.73 to 1.60 g, fruit length from 16.42 to 27.29 mm, fruit diameter from 7.77 to 12.34 mm. The shape indexes of fruits varied from 1.51 to 3.52. The analysis of the coefficient of variation showed the difference of variability of morphological signs between *L. caerulea* samples. Data showed that the most variability of important selection signs is the fruit weight from 14.09 to 34.50 %. The results indicated a high positive correlation between fruit weight and fruit diameter ($r = 0.847$).

The outcome of the research point to the fact that the Ukrainian gene pool of *L. caerulea* is a rich source of genetic diversity and might be used in selection for creating new genotypes and cultivars. The complexes study of phytochemical characters of the available Ukrainian genotypes was started by Ukrainian, Slovak and Russian scientists in Slovak Agricultural University in Nitra (Institute of Biodiversity Conservation and Biosafety). The comparison of phytochemical characters between Russian ancestors and its seed's generation will be made next year.

Keywords: *Lonicera caerulea*, fruits, morphometric parameters.

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**BIOLOGICAL ACTIVITY OF LEAVES OF NON-TRADITIONAL PLANTS**

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Fruits constitute is a large group of functional food, whose consumption delivers several health benefits, but very limited studies about the leaves of plants especially lesser-known and non-traditional plants, among which fruit plants. Leaves of non-traditional plants are one of the promising sources of antioxidants. They can use in the tea production and may have potential health benefits as a therapeutic aid in many illnesses which could be attributed to their antifungal, anti-inflammatory, antimicrobial and antioxidant activities.

The aim of the research is the determination of the total antioxidant activity and the content of phenolic compounds of the leaves of 10 species of non-traditional plants, namely, *Amelanchier alnifolia* (Nutt.) Nutt. ex M. Roem., *Aronia mitschurinii* A.K. Skvortsov & Maitul., *Castanea sativa* Mill., *Cornus mas* L., *Diospyros kaki* L., *Diospyros lotus* L., *Diospyros virginiana* L., *Chaenomeles japonica* (Thunb.) Lindl., *Pseudocycdonia sinensis* (Thouin) C.K. Schneid., *Ziziphus jujuba* Mill.

The raw materials were collected in the 2018 July on the experimental collection of Institute of Biological Conservation and Biosafety of Slovak University of Agriculture in Nitra. Biochemical analyses conducted in the laboratory of the Department of Technology and Quality of Plant Products. Total phenolic content (TPC) was evaluated using the Folin-Ciocalteu reagent assay. Antioxidant activity (AOA) was measured using two different methods (DPPH – 2,2-diphenyl-1-picrylhydrazyl, MRAP – molybdenum reducing antioxidant power).

Significant variability was observed in phenolic compounds content and total antioxidant activity. Total polyphenol content ranged from 38.02 (*Z. jujuba*) to 80.58 (*C. sativa*) mg GAE/g DW, total flavonoid content from 22.47 (*P. sinensis*) to 54.35 (*Z. jujuba*) mg QE/g DW and phenolic acids content from 3.51 (*A. mitschurinii*) to 24.67 (*Ch. japonica*) mg CAE/g DW. All tested samples exhibited DPPH• radical scavenging activities with values from 6.92 (*A. mitschurinii*) to 9.0 (*C. mas*) mg TEAC/g DW. Antioxidant activity by molybdenum reducing antioxidant power method ranged from 109.43 (*A. mitschurinii*) to 322.95 (*C. mas*) mg TEAC/g DW. Differences between the species of non-traditional plant were significant in all observed parameters.

The plants leave extracts consistently exhibited the highest antioxidant activity. Obtained results of phytochemical composition demonstrated the possibility of leaves use of non-traditional plants as sources of valuable bioactive compounds with health-promoting and disease-preventing properties. However, are recommended further studies considering the complex of factors (conditions of growth, stage, etc.) that influence the accumulation of biologically active compounds.

Keywords: non-traditional plants, leaves, antioxidant activity.

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SCANNING ELECTRON MICROSCOPY STUDY OF POLLEN MORPHOLOGICAL CHARACTERS OF *SAMBUCUS NIGRA* L.

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The pollen grains have a definite shape, size, color, structure for each species, genus and family and these characters are useful for systematic botany. The complex of these morphological characteristics and ultrastructure allows determining the differences or similarities between the same and various species and genotypes.

In the Slovak flora, *Sambucus nigra* L. is the most vegetative species from the Adoxaceae E.Mey. family, but pollen grains were not yet studied using by SEM (Scanning Electron Microscopy) in the conditions of Slovakia.

The aim of the work was to study the general characteristics and significant morphological traits of *Sambucus nigra* pollen grains. The studies were performed on pollen obtained from wild-growing twenty *Sambucus nigra* varieties (SN-1–SN-18) and cultivar Haschberg (SN-19–SN-20) cultivated in Slovakia. The pollen grains were studied at the Institute of Biodiversity Conservation and Biosafety in Nitra (Slovakia) and the Laboratory of Department of Tropical and Subtropical plants of M.M. Gryshko National Botanical Garden (Kyiv, Ukraine) using the scanning and transmission electron microscopy SEM. The measurement of morphometric parameters was carried out on 50 pollen grains from each genotype using the AxioVision Rel. 4.8.2.0 program.

The shape of fresh pollen grains is slightly elongated, closer to spheroidal. In outline from the pole – round. The form of dried pollen grains is oval. *Sambucus* pollen is three-furrowed. Furrows are long, with oval, even edges. Exina sculpture is coarse-mesh.

This study showed that there were significant differences the samples in all measured factors. The polar axis of pollen grains values varied from 18.23 to 29.91 μm (varieties) and from 20.99 to 26.85 μm (cv. Haschberg). The equatorial diameter values for wild-growing varieties and cv. Haschberg pollen grains varied from 10.86 to 16.83 μm and from 12.28 to 16.43 μm , respectively. There were no significant differences between pollen grains of wild-growing varieties and cultivar Haschberg. This study confirmed small differences among the genotypes in all measured factors with variation coefficient in the range 2.62–8.62 %. Shape index of tested genotypes varied from 1.08 to 2.36 for wild-growing varieties and from 1.30 to 2.08 for cv. Haschberg.

It was noted that diversity of surface sculpturing of pollen grains in combination with shape and sizes of them enables to use complex of thin morphologic signs for *Sambucus nigra* pollen identifications.

Keywords: *Sambucus nigra*, pollen, SEM, morphology, Slovakia.

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INNOVATIVE TECHNOLOGY FOR THE PRODUCTION OF ORGANIC SUGAR SYRUP OBTAINED FROM SWEET SORGHUM AND ITS USE FOR THE PRODUCTION OF HEALTHY FOODS

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The issue of healthy eating requires the denial of synthetic ingredients and the replacement by natural feedstock to make products based on it with high biological value. Expansion of the use of synthetic sweeteners in the food industry is a result of the decrease in sugar beet areas and sugar production in Ukraine. The use of synthetic sweeteners in the food industry is associated with a high level of sugar equivalent and low prices. At the same time, according to research conducted in different countries of the world, it has been established that synthetic sweeteners lead to hematologic, hepatotoxic, cytogenetic, allergic, neuralgic and other changes in human organs.

Therefore, the research aimed at search of natural sweeteners of plant origin that are biologically active substances adapted to the physiological functions of the human body has been conducted. Such promising vegetable feedstock in Ukraine is sugar sorghum (*Sorghum saccharatum* (L.) Pers.). Stalks juice has a balanced nutritional value, contains easily digestible sugars, amino and organic acids, macro and microelements, and vitamins.

The purpose of the work is to develop a technology for obtaining a sugar-based product from sugar sorghum for its further practical use in food as a sweet ingredient.

The object of research is the technological processes of sugar-containing sorghum syrup production. There were used refractometric and analytical iodometric methods for determining the total content of sugars. The composition of macro and microelements in juice and the end product was determined by the atomic absorption spectrophotometry method, and the qualitative and quantitative composition of the amino acids was determined by the amino acid analyzer T-339 Microtechno.

According to the results of the research, a technology was developed for obtaining a food sugar-containing product from juice of sorghum, which included grinding of stems, juice extraction, separation of pulp, temperature coagulation of nonsucrose substances, two-stage hydrolysis of starch, application of cationic flocculant on the basis of polyhexamethylene guanidine (PGMG), conducting of centrifugal filtration, decolouration and cleaning of sugar sorghum juice with the use of active cellulose sorbents and ultrafiltration and concentration a syrup with final content of dry matter of 70–75 %. The technology allowed to obtain a transparent, amber, sweet, slightly acidic and pleasant smell of food sugar-containing product in industrial conditions. This product has the optimal balance of carbohydrates – sucrose, glucose, fructose (50:33:15) % of total sugars. This balanced composition of the food product allows to recommend it for consumption as a natural sugar substitute. The product contains 19 amino acids, seven of them are essential: threonine, valine, methionine, isoleucine, leucine, phenylalanine, and lysine. The product contains seven microelements: iron, nickel, zinc, copper, cobalt, manganese, chromium that are necessary for carrying out metabolic processes in the human body.

Consequently, sugar syrup from sugar sorghum is a valuable food product, since it contains biologically active substances and may be useful in the production of healthy food products, and also have a wide application in the food industry as a whole.

Keywords: sugar-contain product, food and biological value.

CONTENT OF POLYPHENOLS, FLAVONOIDS AND ANTIOXIDANT ACTIVITY OF FRESH FRUITS AND JELLIES PREPARED FROM DIFFERENT LESS KNOWN FRUIT SPECIES

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Fruits, especially less known species start to be very popular nowadays in gastronomy, medicine, and pharmacy due to the bioactive compounds but also for specific sensory properties. It can be consumed fresh, but it is possible to prepare different kind of products, including jellies. The aim of the study was to determine total antioxidant activity (DPPH and phosphomolybdenum method) and the content of phenolic compounds of the fresh fruits and jellies made from one species (*Actinidia chinensis* Planch *Cornus mas* L., *Diospyros virginiana* L., *Chaenomeles japonica* (Thunb.) Lindl. Ex Spach, *Lonicera caerulea* L., *Mespilus germanica* L., *Prunus cerasus* L., *Pseudocyonia sinensis* C.K.Schneid., *Schisandra chinensis* (Turcz.) Baill., *Viburnum opulus* L.) and jellies from two species (*Pseudocyonia sinensis* + *A. chinensis*; *P. sinensis* + *C. mas*; *P. sinensis* + *D. virginiana*; *P. sinensis* + *Ch. japonica*; *P. sinensis* + *L. caerulea*; *P. sinensis* + *M. germanica*; *P. sinensis* + *P. cerasus*; *P. sinensis* + *Sch. chinensis*; *P. sinensis* + *V. opulus*).

Significant variability was observed in phenolic compounds content and total antioxidant activity. Total polyphenol content of the fresh fruits and jellies made from one species ranged from 6.02 (*A. chinensis*) to 12.30 (*V. opulus*) mg GAE/g (gallic acid equivalent) and from 5.90 (*D. virginiana*) to 12.39 (*P. sinensis*) mg GAE/g; total flavonoid content from 0.06 (*C. mas*) to 3.33 (*L. caerulea*) mg QE/g (quercetin equivalent) and from 0.06 (*C. mas*) to 2.29 (*L. caerulea*) mg QE/g, respectively. The total polyphenol and flavonoid content in jellies made from two species ranged from 7.40 (*P. sinensis* + *Ch. japonica*) to 11.88 (*P. sinensis* + *A. chinensis*) mg GAE/g and from 0.10 (*P. sinensis* + *P. cerasus*) to 0.32 (*P. sinensis* + *L. caerulea*) mg QE/g, respectively. All tested samples exhibited DPPH• radical scavenging activity of the fresh fruits and jellies made from one species with values from 1.76 (*M. germanica*) to 6.46–6.47 (*L. caerulea* and *V. opulus*) mg TEAC/g (Trolox equivalent antioxidant activity) and from 1.52–1.57 (*M. germanica* and *A. chinensis*) to 6.43 (*C. mas*) mg TEAC/g, respectively. Antioxidant activity of tested samples made from one fruit species evaluated by phosphomolybdenum method ranged from 27.69 (*P. sinensis*) to 84.04.95 (*D. virginiana*) mg TEAC/g and from 78.34 (*P. sinensis*) to 264.18 (*P. cerasus*) mg TEAC/g DM, respectively. In samples made from two fruit species values of antioxidant activity (DPPH method and phosphomolybdenum method) oscillated from 2.75 (*P. sinensis* + *M. germanica*) to 5.51 (*P. sinensis* + *D. virginiana*) mg TEAC/g and from 107.17–108.39 (*P. sinensis* + *M. germanica* and *P. sinensis* + *A. chinensis*) to 161.64–163.40 (*P. sinensis* + *Ch. japonica* and *P. sinensis* + *Sch. chinensis*) mg TEAC/g, respectively. Differences between the tested samples were significant in all observed parameters.

Thus, results showed that investigated less known fresh fruits exhibited high antioxidant activity as well as jellies from them. These data can be used for the food production industry and for pharmacological investigations.

Keywords: non-traditional fruits, bioactive compounds, reducing power, DPPH•

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**PRELIMINARY PHYTOCHEMICAL SCREENING OF ORCHID PLANTS GROWN
EX SITU AND IN VITRO**

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Screening of the living plant collections, maintained in Botanic Gardens, aimed at identifying the potential sources of biologically active compounds is an extremely promising area for various research projects. Using the bank of sterile plant tissue cultures of the Laboratory of plant biotechnology and tropical plant collections of M.M. Gryshko National Botanic Garden (NBG), the phytochemical screening of the extracts of 20 orchid species from *Dendrobium* Sw. genus has been undertaken. High-performance liquid chromatography and laser desorption/ionization mass spectrometry were used to analyze the composition of the leaves extracts derived from the plants grown under different conditions (both *ex situ* and *in vitro*). Phenolic (hydroxycinnamic and hydroxybenzoic) acids and flavonoids in glycoside form were found to be the main groups of bioactive compounds of the extracts. Flavonoids, in their turn, were presented mainly by flavonols and flavones, with quercetin, kaempferol, rhamnetin, apigenin and luteolin being the most abundant aglycons. The extracts also contained the anthracene and phenanthrene derivatives, alkaloids, coumarins, furanocoumarins, terpenoids; the extract of *Dendrobium chrysanthum* Wall. ex Lindl. (grown *ex situ*) were found to include also catechins.

The antioxidant properties of the extracts in the reaction with DPPH stable free radical were assessed. Four extracts from the plants grown *ex situ* and one extract from the plant grown *in vitro* were found to exhibit high antiradical activity, inhibiting half or more of free DPPH radicals. The comparison of the extract from the plant grown *ex situ* and *in vitro* revealed that in most cases the first ones had higher antioxidant properties.

To develop dosage forms for prolonged antioxidants release, two types of composite materials were prepared using the extracts as an active ingredient and fumed silica or silica-gelatin matrix as auxiliary components. Adsorption/precipitation of the extracts on fumed silica surface was found to lead to the prolonged release of only part of bioactive compounds of a particular structure, while the inclusion of the extracts in silica-gelatin matrix allows achieving significant and non-specific deceleration of the desorption of all the extracts components. Thus, the silica-gelatin matrixes with embedded orchid extracts seem to be promising dosage forms for prolonged antioxidants release: the components of the extracts are effective natural antioxidants while silica-gelatin matrix provides their gradual release and prolonged action.

Keywords: plant extracts, Orchidaceae Juss., antioxidants, flavonoids.

Acknowledgments

The work was supported by the Targeted Comprehensive Interdisciplinary Research Program of NAS of Ukraine 'Molecular and cellular biotechnology for medicine, industry and agriculture'. The investigations were accomplished on the basis of the sterile plant tissue cultures collection of tropical and subtropical plants Department of NBG. Since 1999 the whole collection of tropical and subtropical plants (including orchids), maintained both *ex situ* and *in vitro*, has the status of a National Heritage Collection of Ukraine and is supported through State funding.



EXPERIENCE OF OBTAINING OF PLANT TISSUE CULTURES OF CACTACEAE JUSS.

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The state Botanical Institutes of Ukraine keep unique, ones of the biggest collections of succulent plants in Eastern Europe. Among them, Cactaceae Juss. is one of the numerous families of Angiosperms which inhabit arid parts of New World. Many of them are important agricultural species. In fact, most of the species of Cactaceae are in danger of extinction or they exist only in collections.

According to the mentioned above, as objects of study, three rare species of cacti were selected that are endangered in natural habitats.

Astrophytum asterias (Zucc.) Lem. is in the most endangered position. The species belong to Appendix I of the CITEC and to the vulnerable species category of IUCN. *Blossfeldia liliputiana* Werderm. is a monotypic genus of cacti that belong to Appendix II of CITES. *Strombocactus disciformis* (DC.) Britton & Rose is a monotypic species of the genus, endemic species of Mexico which belong to the red list of IUCN (status "vulnerable species") of Appendix I of CITEC and to the National List of endangered plant species of Mexico.

The aim of our study is to obtain sterile tissue cultures, to investigate the particularities of organogenesis on the initial stages of ontogenesis and approbation of micropropagation procedure of the mentioned taxonomic groups of Cactaceae.

The results of the study are represented by the approbated procedure of sterilization of intact material and obtained sterile cultures of these species (ethanol (70 %) – 0.5 min; sterilized distilled water (SD) – 5 min; thimerosal (0.1 %) – 16 min; SD – 10 min; Domestos – 8 min; H₂O₂ (10 %) – 10 min; SD – 10 min). The expediency of the use as primary explants stems of juvenile plants grown *in vitro* from embryos is shown.

The possibility of obtaining of the necessary amount of plant material by the way of indirect organogenesis is proved. The conditions and content of nutrient media for obtaining their primary callus are selected.

It was defined that for the experimental species of Cactaceae, light and space orientation of the explant are the key factors in the primary morphogenic callus formation. The conditions of the successful induction of the formation of the morphogenic callus and initiation of hemorhyzogenesis in the sterile conditions are defined. The contents of nutrient media and conditions of cultivations for all stages of micropropagation were selected. The regenerated plants of experimental species of cacti were obtained, and the procedure of the conditions of their postaseptic adaptation was approbated.

Keywords: *in vitro*, *Astrophytum asterias*, *Blossfeldia liliputiana*, *Strombocactus disciformis*.

Acknowledgments

The experiments of the study were accomplished on the basis of the sterile tissue cultures collection of the Tropic and subtropic plants apartment of the M.M. Gryshko National Botanical Garden that from 1999 has a status of National Heritage of Ukraine and is supported by the definite state program.

**ANTIOXIDANT ACTIVITY OF EXTRACTS FROM *PHYTOLACCA AMERICANA* L. BERRIES****Raisa Ivanova**

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Phytolacca americana L. (American pokeweed) is a herbaceous perennial plant that can serve as a raw material to obtain the pharmaceutical and medicinal products as well as to extract the natural red colorant from *P. americana* berries for food and textile industries.

The aim of this work was to determine the antioxidant activity of *P. americana* berries extracts obtained under various conditions of antioxidant and colorant substances extraction.

The antioxidant activity was evaluated by potentiometric procedure, studying of peroxy radical scavenging activity of berries extracts and expressed by gallic acid equivalent (GAE). The polyphenolic content was appreciated by the Folin-Ciocalteu method. The concentration of colorant substances in extracts was determined using UV-Vis spectrophotometry at 520 nm. The *P. americana* berries were harvested in the 2018 year in Chisinau area. The aqueous and water-alcoholic extracts were obtained from fresh and dried berries.

The biggest amount of polyphenolic and colorant substances was found in aqueous extracts. Using for extraction the water-alcoholic solution with a concentration of 40 and 95 % led to a diminution of polyphenolic content by 1.5–2.0 times and reduced the concentration of colorant substances by 3.5–4.0 times in comparison with aqueous extracts. To mention that red colorant in all obtained extracts proportionally dissolved concomitant with extract diluting and its concentration was easily determined by comparison the curves of optical density dependences at 520 nm on the dilution degree of extract. These dependencies were characterized by high approximation values ($R^2=0.994-0.995$). The color of obtained extracts modified from crimson bright (95 % water-alcoholic extracts) to violet (aqueous extracts) depending on the rate of colorant substances in the dry residue of extract, which varied from 0.94 to 5.12 %.

Evaluated antioxidant activities of *P. americana* berries extracts were in direct proportional dependences on the polyphenolic contents ($r^2=0.956$). Among the tested extracts, the aqueous extracts demonstrated stronger antioxidant activity equal with 17.52 ± 0.04 and 28.87 ± 0.88 μM GAE/g of dry residue, respectively extracts obtained from dried and fresh berries. The water-alcoholic extracts exhibited the antioxidant activity that ranged from 7.53 ± 0.09 μM GAE/g (extracts with 95 % alcohol from dried berries,) to 19.27 ± 0.52 μM GAE/g (extracts with 40 % alcohol from fresh berries).

To conclude, the *P. americana* aqueous extracts from fresh and dried berries was richer in biochemical constituents and possessed the highest antioxidant activity. On the other hand, these extracts are unstable to degradation and this fact must be taken into account when operating with them.

Keywords: *Phytolacca americana*, berry, extract, polyphenolic, colorant, antioxidant activity.

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EFFECT OF SILICEOUS MINERALS ON TOMATO (*SOLANUM LYCOPERSICUM* L.)

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The control of plant processes by activating growing up and physiological and biochemical processes of both decorative and agricultural species are very relevant since it enables to manage the development of plants. The growth of shoot and root of the plants depends not only on the effect of exogenous factors but also on the effect of silicon-based natural minerals, such as analcime and diatomite.

The tomato is edible berry (red, yellow and other) of the *Solanum lycopersicum* L. plant are grown in many countries of the world and tomato plants is very sensitive to environmental conditions. Our research was focused on the effect on natural siliceous minerals (analcime and diatomite) on the growth of tomato plants (*Solanum lycopersicum* var. Lyana).

Experimental work was carried out in the Department of Allelopathy M.M. Gryshko National Botanical Garden NAS of Ukraine in 2017–2019. The plants were grown in the sand in laboratory condition (temperature in the laboratory was kept 23–29 °C, the humidity of 65–80 %, lighting is natural, substrate humidity in 200 ml container was kept 40–60 %).

It is known, that SiO₂ does not affect tomato plants at the juvenile stages of development and recommended bring SiO₂ in the soil at the flowering stage (Ma, Takahashi, 2002). We tested the effect of analcime and diatomite in a dose of 250 mg per 200 ml substrate. The control was without siliceous minerals. The experiment was conducted in 6 replicates, each container was sown in 8 seeds.

Data showed the effect of siliceous minerals was noticed already at the stage of germination of tomato seeds: in control grow up 81.3 % seeds, in analcime effect grow up 93.8 % seeds, in diatomite effect grow up 89.6 % seeds in each container in variants. The length of tomato plants (top and root) under siliceous minerals effect also increased: top length on analcime effect was in 1.2 more than control; root length on diatomite effect was in 2.1 more than control roots. The weight of the root raw mass in variants also varied from control in 1.2–1.4 due to the formation of lateral and additional roots. The analysis of the data of photosynthetic pigments showed an increase in chlorophyll an in the analcime effect, which indicates the intensity of growth processes.

Thus, the data showed that siliceous minerals effects were observed in the juvenile stage of development in tomato plants. In addition, analcime and diatomite contribute to the formation of more flowers, than in control. The addition siliceous minerals promote the formation of fruits in tomato plants.

Keywords: tomato *Solanum lycopersicum* L., siliceous minerals, analcime, diatomite.



YEAR (2019) OF SIGNIFICANT ANNIVERSARIES OF SLOVAK BEEKEEPING

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Beekeeping has a long and rich tradition in Slovak Republic and is still one of the most advanced in Europe and the world. In the past, several Alumbados, namely Anton Bernolák, Juraj Fándly, Ján Glosius, Ján Čaplovič, contributed to the development of our beekeeping. This year marks the 150th anniversary of the foundation of the Slovak Beekeepers Association and the 100th anniversary of the Regional Centre of Beekeeping Societies in Slovakia. The first attempt to establish a central beekeeping organization in Slovakia was the establishment of the Slovak Beekeepers Association in 1869 in Pružina. Its founder was Roman Catholic pastor, national revivalist Štefan Závodník (1813 Horná Poruba – 1885 Pružina). In the July issue of *Obzor* magazine in 1869, Štefan Závodník issued a response to Slovak beekeepers regarding the founding of the Slovak Beekeepers Association. Starting with the program and statutes, he became its first chairman. Ján Kiš, a successful fruit farmer and beekeeper, became the vice-chairman. His wife Jozefína Kišová was the first Slovak beekeeper. In the field of folk education, Štefan Závodník contributed not only to the development of Slovak Beekeeping and Pomology but also to the establishment of Sunday schools, handicrafts, moral, economic and financial associations. He was a Slovak candidate in the Hungarian Assembly elections. He was persecuted and sentenced by Hungary's secular and ecclesiastical Authorities. He is the author of several dramas and poems. He collaborated on publishing Čajda's *Beekeeper in Slovakia* (1871). In 1872 in the *Obzor* magazine in Issue 34 was published an appeal for the Slovak public to collect objects of all human activity and natural beauty photographs for the World Exhibition in 1873 in Vienna. After this appeal, in addition to Slovaks from Slovakia and Slovaks from the Great Plain, apiculture items were sent for this exhibition. Attempts by the Pružina's Beekeeping Association for its organized form in Slovakia in the 19th century failed due to national repression by the Hungarian government, which did not recognize the statutes of the Association. Therefore, the Association in 1875 ceased to exist. In 1918 the establishment of the Czechoslovak Republic and the acquirement of national freedom, after the 50 years, the unification and central management of beekeeping associations, initiated by experienced and enthusiastic Slovak beekeepers. This happened on August 15th 1919, at the constituent General Assembly of the Regional Centre of Beekeeping Associations for Slovakia established in Bratislava. The date of the General Assembly was not accidental. It was convened by the organizers on the 50th anniversary of the establishment of the first National Beekeeping Association in 1869 in Pružina. They declared that it was a renewal and continuation of this Association. Delegates representing 27 associations attended the constitutive General Assembly of the Regional Centre of Beekeeping Associations for Slovakia. Dr. Ján Gašperík (1876 Dovalovo – 1949 Nováky), a dedicated organizer, innovator, and historian of beekeeping, became a chairman. The Beekeeping Organization has undergone several organizational and name changes over the years. The independent Slovak Beekeepers Association, based in Bratislava, was re-established in 1968. The uniform Beekeeping Organization under the name Slovak Beekeepers Association was functioning until 1990. After new socio-economic conditions, several smaller associations were formed.

Keywords: beekeeping, Slovak Republic, history, Beekeepers Association.



LESSER KNOWN FRUIT SPECIES AS A SOURCE OF VALUABLE BIOACTIVE SUBSTANCES

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The lesser known fruit species have been more and more valued as a new source of food. They can be characterized by high content of bioactive substances, especially polyphenols and triterpenoids. Due to this fact they have been ranked into a new group of natural functional or novel food. Moreover, we can also mention nondemanding cultivation, high adaptability into new conditions of introduction, they have not been suffered from diseases and pests. In the territory of Slovakia these species can be divided into 4 groups:

- a) neglected, forgotten or underutilized species (black mulberry, cherries, European cranberry, black crowberry, etc.);
- b) wild fruit with interest for breeding to increase the content of bioactive substances, size of fruit (cornelian cherry, rowanberry);
- c) another native species in the territory of Slovakia without interest to explore them (blackthorn);
- d) introduced, promising species in the aspect of cultivation and utilization (honeyberry, chokeberry).

The aim of the study was to compare polyphenolic spectrum and antioxidant activity of two native – black crowberry (*Empetrum nigrum* L.), European cranberry (*Viburnum opulus* L.) and one introduced species – honeyberry (*Lonicera caerulea* L.). The dominated polyphenols were separated and detected by HPLC method, antioxidant activity by DPPH method.

The results of continual comparative studies on lesser known fruit species (black crowberry, European cranberry, and honeyberry) in 2016–2018 has proved that honeyberry represented the valuable source of phenolic acids, especially gallic acid 23.15 ± 1.53 , quercetin 14.18 ± 3.88 , and rutin 29.18 ± 0.56 $\mu\text{g}\cdot\text{g}^{-1}$ fresh weight. Black crowberry displayed the valuable content of gallic acid 23.43 ± 4.33 together with ferrulic acid 89.13 ± 3.9956 $\mu\text{g}\cdot\text{g}^{-1}$ fresh weight, European cranberry rutin 26.87 ± 1.38 $\mu\text{g}\cdot\text{g}^{-1}$ fresh weight of fruit. In the same time black crowberry showed the highest antioxidant activity 6.65 ± 0.09 (gallic acid $\text{mg}\cdot\text{g}^{-1}$ fresh weight of fruit). There has been noticed statistically significant differences in antioxidant activity and individual polyphenols among assayed species ($P < 0.05$).

The results of the experiment confirmed that three underutilized species – black crowberry, European cranberry honeyberry has represented a valuable source of polyphenols displayed high antioxidant activity. Therefore the assayed species can be widely utilized in food industry and processing as well.

Keywords: lesser known fruit species, bioactive substances, comparative study, polyphenols, antioxidants.

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**BIOLOGICAL ACTIVITY OF *DIOSPYROS KAKI* THUNB. LECTIN****Iryna Karpova, Larisa Palchykovska, Valentyna Lylo**

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Persimmon – *Diospyros kaki* Thunb. (*Ebenaceae*) is a dietary and medicinal plant used in alternative medicine of the peoples of the East. Tea made from dried persimmon leaves is consumed in Japan and Korea. It has been shown that the components of the extract of persimmon leaves exhibit antioxidant activity, antitumor effects, regulate the activity of the angiotensin-converting enzyme (ACE), reduce the manifestation of allergy symptoms, etc.

In our previous work, the sialospecific lectin from sepals separated from ripe persimmon fruits was first obtained. Interest in lectins – carbohydrate-binding proteins is constantly growing due to their antiviral, antibacterial and antitumor properties. The lectin was shown to induce the expression of interferon-alpha (IFN α) gene and some of its target genes in rat liver. This could be the indirect manifestation of the antiviral potential of the lectin.

Subsequent studies have revealed the antiviral activity of persimmon lectin against HIV, herpes type 1 and type 2, and influenza A/FM/1/47/H1N1/ in mammalian cell culture *in vitro*.

The aim of the study presented was to determine other targets sensitive to the lectin action. To study the ability of *D. kaki* lectin do effect on RNA synthesis *in vitro* the model transcriptional system that included bacteriophage T7 polymerase (T7RNAP) as described in (Palchikovska et al., 2005) and linear DNA of *pTZ19R** plasmid as a template was used. Persimmon lectin was isolated by the modified procedure of isoelectric focusing followed by ammonium sulfate fractionation. Hemagglutinating activity of the lectin (GAA) was estimated visually in serial two-fold dilutions in microtiter plates followed by adding of 2 % suspension of native human or formalin-fixed sheep erythrocytes. It was presented by logarithm (log₂) of the last lectin dilution where GAA was observed. Lectin preparations were characterized by SDS-PAGE according to Laemmli method.

Using the method of isoelectric focusing, which allows separating different isoforms of the protein, it was shown that the major lectin from persimmon sepals in the presence of beta-mercaptoethanol forms one protein zone in SDS-PAGE, which corresponds to ml. mass of about 30 kDa. From this, it followed that this protein consists of at least two identical subunits. Our studies focused on elucidation the cell targets sensitive for the persimmon lectin demonstrated the evident effect on RNA synthesis *in vitro* catalyzing by T7 RNAP. The lectin of *D. kaki* in the transcription assay showed concentration-dependent inhibitory activity in the range of 1.5–25.0 $\mu\text{g/ml}$, where concentrations 12.5 and 25.0 $\mu\text{g/ml}$ completely inhibited the RNA synthesis. According to the results obtained, we suppose that at least one of the lectin targets may be the DNA-dependent synthesis of RNA – the way to activate/inactivate gene expression.

Keywords: *Diospyros kaki* sepals, lectin, DNA-dependent synthesis of RNA.

USING OF DRONES FOR CROP PHENOTYPING UNDER BREEDING PROCESS

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Modern breeding in agriculture requires testing plenty of phenological traits across numerous variants and repetitions under field conditions. Experimental fields used for the plant breeding may contain several thousands of test plots requiring simultaneous quantitative assessment. Human assessment 'by eye' or traditional laboratory analysis can't be effective for this task. Using unmanned aerial vehicles (UAV) also known as drones equipped with regular and multispectral cameras can be the new effective approach in plant phenotyping. Images taken from air can be processed for retrieving plenty of plant traits. Modern drones can be used for aerial survey in fully automatic mode that provides data uniqueness and allows automatic data processing. However, due to novelty of this approach, there are no standard procedures of data retrieving and processing yet.

Here we describe the practical experience of using the drones for quantitative measurement of phenological parameters of plants grown on experimental fields. We aimed to develop the optimal protocol of aerial survey and methods of data processing for identification of single plants, estimation number of plants, plant sizes and physiological status on different growth stages. High accuracy, performance, and reasonable costs were the main requirements for the developed procedures.

We performed single and regular aerial surveys of rapeseed and wheat crops using quadcopters from DJI series equipped with a user-grade RGB camera and Parrot Sequoia multispectral camera. The experimental fields contained from 3000 to 7000 plots with 1x2 m size each. The list of tested parameters included: plant count per plot, plant area, plant height, green/dry ratio, photosynthetic potential, weeds contamination level, and flowering level. We aimed to optimize survey settings such as flight altitude, flight speed, frequency of image capturing and camera settings. We also tested the advantages and limitations of the multispectral camera over a regular RGB camera. Finally, we developed algorithms of data processing using GIS environment. Drone-derived results were compared with data obtained by manual in-field tests and manual image inspections.

The results indicate high efficiency of using drones for plant phenotyping and advantage of this method over traditional in-field methods. Drone-based methods demonstrated about 90 % accuracy in assessing of plant parameters. For metric parameters such as plant count and plant sizes as well as for flowering level, the regular RGB camera was more effective comparing to the multispectral camera because of bigger frame size. Recommendations for the optimal data quality as well as of limitations of the drones are discussed.

Keywords: Drones, UAV, Plant phenotyping, experimental fields, breeding.

**CORNELIAN CHERRY (*CORNUS MAS L.*): GENESIS OF UKRAINIAN BREEDING CULTIVARS****Svitlana Klymenko**

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According to different sources, the polymorphic family *Cornaceae* Bercht. et J. Presl. includes from 50 to 100 species. Subgenus *Cornus* L. in this family has a great interest. It has a fragmented areal in the world and represented by four species: *Cornus mas* L. (cornelian cherry) – in the west of the mainland, *C. officinalis* Sieb. et Zucc. – in Japan, China, and Korea, *C. chinensis* Wanger. – in the central region of China and *C. sessilis* Toor. – in North America. Cornelian cherry is the culture meeting the standards of the time. According to our researches the cornelian cherry yields abundant and is a stable crop in culture, and bares large juicy fruits, while not demanding thorough care, its cultivation is very paying. The main biological characteristics of the cornelian cherry: there is no periodicity fruiting, the biological productivity in favorable conditions is 25–100 kg tree depending on age. The duration of the productive period is 100–150 years. Plants are practically not damaged by pests and diseases. Cornelian cherry has become an objective of the selection work in the world rather recently. The systematic work on the formation of the collections, selection have been carried out lately in Austria, Bulgaria, France, Germany, Poland, Turkey, Slovakia, and Ukraine.

The aim of our investigation to analyze the state, successes, and perspective of cultivation of cornelian cherry and provide information on breeding work and cornelian cherry cultivars in Ukraine.

Objectives of research are genetic pool of the cornelian cherry of the M.M. Gryshko National Botanical Garden of NAS of Ukraine (NBG), which presents a rich variety of biological and economic properties. It processes about 100 genotypes collected from wild and cultivated plants in Ukraine and more than forty cultivars of a selection of NBG. The basic methods of working with cornelian cherry were analytical and synthetic selections. Analytic selection: the results of spontaneous selection were used for identifying the most perspective cultivars, the synthetic selection – were created cultivars with specific properties and features. The basic method of synthetic selection is hybridization. We used also the results of somatic mutations. The genetic pool of cornelian cherry in Ukraine is formed mainly by the cultivars selected by the NBG. The fruits of cultivars are bottle-shaped, pear-shaped, oval form; dark-red, cherry-colored, pink, and yellow.

As a result of breeding work, winter-hardy, highly productive of cornel were created that are promising for industrial and farming crops in the Forest-Steppe and Polesye, as well as in the Steppe regions of Ukraine (under irrigation conditions). Industrial plantations are able to function for many decades. Cornelian cherry has not been included in the State Register of Cultivars of Ukraine until 1990. The list has been filled up by the work of the NBG. There are 14 cultivars of cornelian cherry of the selection of NBG officially were registered in the State Register of Cultivars of Plants of Ukraine. The cultivars of the analytical selection – Alesha, Grenader, Elena, Kozerog, Lukyanovsky, Mriya Shaidarovoj, Nezhny, Nespodyvanyi, Nikolka, Original, Priorsky, Pervenetz, Semen, Suliya, Yantarnyi, Ugolek, Vavilovetz, Vyshgorodskiy; of synthetic selection – Elegantnyi, Korolovyi, Korolovyi Marka, Kostya, Radost, Starokievskiy, Yevgenia; of the somatic selection – Ekzoticheskyi, Svetlachok, Present.

Keywords: cornelian cherry, selection, gene pool, cultivars, Ukraine.

DETERMINATION OF ANTIOXIDANT CAPACITY AND POLYPHENOLS CONTENT IN FRUITS OF CULTIVARS OF *CHAENOMELES JAPONICA* LINDL. EX SPACH.**Svitlana Klymenko¹, Alicja Zofia Kucharska², Narcyz Piórecki^{3,4}**

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Consumer interest in health foods has increased market demand for high-quality fruits such as the *Chaenomeles* spp. (flowering quince, Japanese quince). This fruit species possesses a significant potential for cultivation in monocultures as well. *Chaenomeles* cultivation is slowly growing throughout the world as it delivers delicious and nutritious fruits. The genus *Chaenomeles* Lindl. belongs to the Rosaceae Juss. family and comprises four species: *C. cathayensis* (Hemsl.) C.K.Schneid., *C. japonica* (Thunb.) Lindl., *C. speciosa* (Sweet) Nak. and *C. thibetica* T.T.Yu. Japanese quince (*Chaenomeles japonica*) is a shrub naturally occurring in central and southern Japan. Compared to the other three species, Japanese quince is best suited to the climate of northern Europe, where it was introduced in 1869. In traditional Chinese medicine, the fruits of various species of *Chaenomeles* have been used for thousands of years in the treatment of rheumatoid arthritis, hepatitis, asthma, and the common cold, and also have been reported to have anti-inflammatory, antinociceptive, antimicrobial, antioxidant, immunoregulatory, antitumor, hepatoprotective, antiparkinsonian, and antioxidant activities. The fruits contain many bioactive components. Cold-pressed *Chaenomeles japonica* seed oil is one of the richest sources of natural micro constituents, such as fatty acids, carotenoids, squalene, polyphenols, phytosterols, tocopherols, and other compounds with high biological activity.

The aim of this work was to evaluate the biological activity of fruits of *Chaenomeles japonica* cultivars, as potential species for cultivation and use in Ukraine.

The objects of the research were 14 cultivars of *Chaenomeles japonica* the selection of M.M. Gryshko National Botanical Garden of NAS of Ukraine (Kyiv). The raw materials were collected in the season of full ripeness (October). Antioxidant activity (AOA) was measured using three different photometric methods (DPPH – 2,2-diphenyl-1-picrylhydrazyl, ABTS – 2,2-azino-bis-3-ethylbenzothiazoline-6-sulfonic acid, FRAP – ferric-reducing antioxidant power). Total polyphenol content (TPC) was evaluated using the Folin-Ciocalteu reagent assay.

The results for AOA ($\mu\text{mol Trolox/g}$) determined by the DPPH method varied from 10.08 ± 0.47 to 21.42 ± 0.80 , those obtained by the ABTS method varied from 31.13 ± 4.66 to 70.87 ± 4.60 , and those obtained by the FRAP method varied from 14.97 ± 0.78 to 42.51 ± 1.80 . The results for TPC varied from 162.46 ± 2.41 to 408.09 ± 8.67 mg/100 g.

The results showed that all fruit extracts exhibited strong antioxidant activities, which generally correlated positively with the total phenol contents. Our results point to the fact that observed plants of cultivars *Chaenomeles* the selection of M.M. Gryshko National Botanical Garden are suitable natural source of compounds, which have high antioxidant activity. This means that the plants of *Chaenomeles japonica* may be used as a source of new health resources when considering nutritional properties of the world's less traditional fruit species.

Keywords: *Chaenomeles japonica*, cultivars, fruits, antioxidant activity, polyphenols contents.



ANTIOXIDANT ACTIVITIES AND PHENOLIC COMPOUNDS IN FRUITS OF CULTIVARS OF CORNELIAN CHERRY (*CORNUS MAS L.*)

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Cornelian cherry (*Cornus mas L.*) is one of the most valuable fruit plants in the family Cornaceae Bercht. et J. Presl. It is a very ancient cultural plant in Ukraine known from times of Kiev on Rus. It was widely used as a valuable food and medicinal plant. All parts of the plant cornelian cherry were widely used in folk medicine for the prevention and treatment of many diseases – scarlet, fever, anemia, diabetes, gastrointestinal, skin, and others.

Fruits and drugs obtained from them (decoctions, tinctures, teas, concentrates of fresh and dried raw materials) exhibit antiscorbutic, general health-improving, tonic, astringent, temporary hypotensive, diuretic effect. Fresh fruits are recommended in amount 10–12 g/day for neurasthenia, common weakening, joint pains, infectious hepatitis and other. Chemical composition of fruits of cornelian cherry is quite rich. Among active compounds, there are flavonoids (anthocyanins, flavonols), tanins, triterpenoids, iridoids and so-called P-active compounds. Fruits and other parts of plant are used as active antimicrobial remedy for various ailments due to the high content of biologically active substances.

The aim of this study was to evaluate the antioxidant activity and phenolics content of cornelian cherry cultivars, which are used for cultivation in Ukraine.

The fruits of 20 cultivars of cornelian cherry collected in the M.M. Gryshko National Botanical Garden of NAS of Ukraine (NBG) were the objects of these investigations. The raw material was collected in the period of full ripeness (September). Antioxidant activity (AOA) was measured using three different photometric methods – DPPH, ABTS and FRAP. Total phenolic content (TPC) was evaluated using Folin-Ciocalteu reagent assay.

The results for AOA (umol Trolox/g) determined by the DPPH method varied from 5.94 (Kozerog) to 16.56 (Kostia), ABTS method varied from 13.560 (Koralovyj Marka) to 33.96 (Semen), FRAP method varied from 8.45 (Koralovyj) to 22.49 (Kostia). The results for TPC varied from 91.34 (Kozerog) to 289.79 (Bolgarskyj) mg/100g. There was recorded a positive linear correlation between antioxidant activity and total phenolic content in the examined plant material.

Obtained data has shown that investigated cultivars have a potent antioxidant activity that can be used for further investigation and usage of cornelian cherry.

The results of our study have also shown that cornelian cherry is an important traditional plant that deserves special attention for widespread growing in Ukraine due to its high biochemical characteristics, as well as useful nutritional and medicinal properties. The fruits of cornelian cherry are promising sources of biologically active substances.

Cornelian cherry fruits are a rich source of nutrients for human. Currently this plant is less known and this new source can be potentially used as functional food or value added ingredients in the future in our dietary system.

Keywords: cornelian cherry, cultivars, fruits, antioxidant activity, phenolics content.



ANTIMYCOTIC EFFECT OF SOME ESSENTIAL OILS ON *CANDIDA* CLINICAL ISOLATES

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The significance of opportunistic pathogenic bacteria in the development of inflammatory diseases and complications is shown to be continuously growing over the past several decades. Of them, the spread of antibiotic-resistant agents of opportunistic infections has become a most burning problem. Under such conditions, it becomes especially important to perform research aimed at the search for alternative anti-microbial materials. The sources for such materials are the plants that have for a long time been used in popular and traditional medicine. The plant-based materials, essential oils in particular, often demonstrate a high level of direct antimicrobial activity.

The purpose of the work was to study analyze the sensitivity of the *Candida* clinic isolates to essential oils and antibiotics.

For antibiotic susceptibility and antimicrobial activity testing was used disc and agar diffusion method. The analysis of essential oils was carried out by Gas Chromatography method.

Most of the *Candida* strains, even antibiotic-resistant ones, were ascertained to be susceptible to the essential oil of *Thymus vulgaris* L. The essential oils of *Hyssopus officinalis* L. and *Rosmarinus officinalis* L. were shown to be characterized by moderate antibacterial activity. The sensitivity to *Mentha piperita* L. and *Salvia officinalis* L. was strain-specific.

By the level of antimycotic activity, the essential oils may be classified in a descending line beginning with *Thymus vulgaris* showing the most expressed antimicrobial activity, down to *Hyssopus officinalis*, *Rosmarinus officinalis*, *Mentha piperita*, and *Salvia officinalis*. The essential oil of *Matricaria recutita* L. showed no antimycotic activity.

The obtained results have proved the actuality of further studies of the impact of essential oils upon microorganisms, including those with multiple resistances to medical antibacterial preparations.

Keywords: *Candida* strains, essential oils, antibiotic-resistant microorganisms, antimycotic activity.



RESEARCH OF EXTRACTION CONDITIONS OF PHYTOCOMPOSITION FOR NON-HORMONAL TREATMENT OF THE MENOPAUSE

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The aim of the research was to study the influence of pharmaceutical factors on the preparation of aqueous extracts from medicinal plants for non-hormonal therapy of menopausal syndrome.

An imbalance of hormones and a sharp decrease in the amount of estrogen negatively affect the well-being and general condition, causing a lot of unpleasant sensations and exacerbation of some chronic diseases. In this regard, the search for alternative treatments for menopausal syndrome, including herbal preparations, is relevant. Preparations that include medicinal plant materials have a wide range of pharmacological activity due to the combination of various groups of biologically active substances in their composition, a slight risk of allergic reactions, a mild effect, a small spectrum of side effects and lower toxicity to the organs of the excretory system in comparison with preparations of microbial, hormonal and chemical synthesis.

In the Ukrainian pharmaceutical market there are very few biologically active substances used for non-hormonal therapy of menopausal syndrome of Ukrainian production, which makes the manufacture of biologically active substances of Ukrainian origin relevant and promising. The advantages of domestic production of medicines in the form of fees include: the availability of a sufficient raw material base, the patient has the opportunity to get the drug at an affordable price.

One of the important stages in the complex of studies when creating new drugs is the rationale for rational technology. Since the medicinal product in the form of a collection is a solid dosage form, and its use in medical practice is advisable in the form of infusions and decoctions, the justification of the optimal manufacturing conditions of both the collection itself and water extracts from it should be based on a complex of pharmacotechnological studies.

Other factors influence the completeness of biologically active substances in the preparation of aqueous extracts, among which the extraction mode plays an important role. Therefore, when developing a rational technology for obtaining water extracts, it is necessary to justify the duration of infusion in a water bath and subsequent infusion at room temperature after removal from the bath.

In order to study the influence of various pharmaceutical factors, three collection fractions studied, which were identical in composition but different in particle size fragmentation, and selected by sieving through sieves No. 1, 2, 3. Medicinal raw materials were milled with the grass cutting. The particle size of the first fraction was 1-2 mm, the second fraction was 2-4 mm, and the third was 4-6 mm.

Raw materials were placed in a heated tunic, filled with purified room temperature water at a ratio of 1:10, taking into account the coefficient of water absorption, insisted on a boiling water bath, left for further cooling at room temperature. Then the resulting infusion was filtered, bringing the total volume of the aqueous extract from the biologically active substances with purified water to the required volume.

We studied the effect of various pharmaceutical factors on the yield of extractives. We determined the dependence of the yield of extractives from the drug collection at various degrees of dispersion of raw materials.

Keywords: phytocomposition, extraction, menopause.



BIOECOLOGICAL FEATURES OF PLANTS SPECIES OF *SALVIA* L. GENUS UNDER CONDITIONS OF THE FOREST-STEPPE ZONE OF UKRAINE

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Fresh and dry green mass species of the genus *Salvia* L. and biologically active compounds derived from it occupy an important place in the manufacture of modern medicines and food products. The purpose of the work was to investigate the variability of bioecological and morphological characteristics of plants and seeds of species *S. officinalis* L., *S. verticillata* L. and *S. patens* Cav., and selected perspective forms for creating new varieties.

Experimental work was carried out in the period 2012–2017 under conditions of the Forest-Steppe in the M.M. Gryshko National Botanic Garden of the National Academy of Sciences of Ukraine. It is established that the most stable data of mass 1000 pcs. of seeds over the 6 years of storage has *S. patens*. The most dependent on the conditions of the cultivation year and the shelf life is the mass of seeds of *S. officinalis*.

The germination of the seeds *S. verticillata* in the third year decreases threefold, in the sixth year – it is practically zero. The germination of the seeds *S. patens* in the first three years remains approximately at the same level and then decreases strongly. The germination and energy of germination of seeds *S. officinalis* during the first three years of the storage gradually increases and for two more years remains at a stable high level. The germination and energy of germination rates decreased in the eighth year to 4 and 1 %, respectively. Under laboratory conditions, the seeds of the species *Salvia* begin to germinate within 3–4 days at a temperature of + 30 °C. In the soil, the seeds of the species *Salvia* germinate within 18–22 days.

Unlike *S. verticillata*, plants *S. officinalis* and *S. patens* in the first year of life do not blossom. Phenological observations show that in subsequent years, *S. verticillata* and *S. patens* are susceptible to prolonged flowering during the growing season. After cutting above ground mass the new inflorescence stems grow and the plants begin to blossom again. The plants of *S. verticillata* have the largest regenerative capacity. No re-blossom *S. officinalis* was observed after the cut.

The greatest productivity of green mass was obtained by plants grown with inter-rows of 55 cm. This dependence also remained during the second cut, but the yield was 30–40 % lower than at the first cut. The highest productivity was achieved due to the increase in the number of shoots per unit area. Morphometric parameters of generative shoots of different variants differ little from each other. The seed yield was higher in the variant with 45 cm row spacing.

Thus, when growing plants on green mass, it is necessary to sow from 55 cm between rows and on seeds – up to 45 cm. Biometric observations allowed us to establish adaptive possibilities, basic patterns of seasonal growth and development rhythms, characteristic features of *Salvia spp.* for breeding. For the first time in Ukraine, two new cultivars of *S. verticillata* and *S. patens* were created – 'Musketeer' and 'Maestro'.

Keywords: *Salvia* species, seeds, germination, productivity.



***DGAT1* GENE POLYMORPHISM INFLUENCE ON A LACTIC PRODUCTIVITY OF UKRAINIAN BLACK-AND-WHITE MILK BREED COWS**

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Lipid metabolism plays a leading role in the formation of dairy and meat productivity of animals. It can influence the following attributes, that fat content in milk, slaughter quality of animals, marbleness and tenderness of the meat, and the amount of hypodermic fat (PCT/AU98/00882). Genes that determine the productive qualities of animals, one of which is the *DGAT1* gene, have been identified. In cattle, the gene *DGAT1* is localized on the 14 chromosomes. The polymorphism of this gene is related to the fat content of cow's milk and its quality, as it participates in lipids synthesis (Grisart, et. al., 2002; Locarte, et al., 2006; Shaydullin and Ganiev, 2017).

The purpose of our research was to study the effect of various genotypes of the large cattle of Ukrainian black-and-white milk breed with gene *DGAT1* on the milk productivity of cows. The study was carried out on animals of Ukrainian black-and-white milk breed of cattle at the NP NULES of Ukraine "Agronomic Experimental Station". Samples of venous blood were obtained for analysis and PCR was performed.

Based on the results of the studies, three experimental groups were formed according to the genotype of animals with *DGAT1* gene: I group – cows with genotype *AA*, group II – *AK* and group III – genotype of *KK*. For each group, the analysis of milk productivity indicators were performed: milk yield for 305 days of lactation, fat content in milk, the quantity of milk fat. Among the animals of the entire examined the population of Ukrainian black-and-white milk breed for the *DGAT1* genome, the genotype *AA* was found most frequently at 57 % of all cases, *AK*-35 %, and *KK* in only 8 %.

The highest rates of lactation for 305 days were obtained from animals of I Group, for the first lactation they produced 3380.35 kg of milk, the second – 46265.50 kg, and the third – 4189.42 kg, what is somewhat inferior to the yield level of cows, that belonged to groups III and II. A similar advantage of heterozygous animals with genotype *AK* was observed for the fat content in milk for the first lactation, however, with age (2nd and 3d lactation), this indicator was slightly higher in cows with the genotype of *CC* – 3.68 % versus 3.59–3.64 and 3.61–3.67 % in analogs with genotypes *AA* and *KK*, respectively. However, it should be noted that throughout the research period, the largest amount of milk fat was obtained from animals of the second group, which, in our opinion, can be explained by the higher levels of these cows yields. The difference in the average of yields compared to cows of the first and third groups was 16.1 and 14.2 kg, respectively.

The results of our research comply with the data of Novak (2008), Oblap (2008), and Shaidullin (2017), who concluded that animals with the genotype *DGAT1 KK* have a higher percentage of fat in milk. As a result of the studies, it can be concluded that animals with the genotype *DGAT1 AK* had the highest yields for 305 days of lactation and the highest amount of milk fat. Cows with the genotype *DGAT1 KK*, were although somewhat inferior to the level of the yield, but had a higher fat content in milk. The obtained data can be used for genotyping of animals to this gene and improving the efficiency of breeding work in order to increase the content of fat in milk.

Keywords: gene polymorphism, lactic productivity, fat content in milk.

BIOLOGICAL ACTION OF THE MICROELEMENTS CITRATES IN HONEY BEES BODY AND THEIR PRODUCTS

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The study of biological effects of microelements to the honey bee colony and their interaction with other elements in the application of mineral additives will allow finding optimal and safe methods for stimulating the resistance of the organism of bees and their productivity.

In the first series, five groups of bee colonies were formed, three in each. The Ist group – conditions of stationary maintenance with saturated sugar syrup (SS) 0.3 l/week/colony, IInd group – experimental, under similar conditions of feeding with the addition of 2 mg of Ni in the form of citrate to the SS, IIIrd group – addition to SS with citrate of Co in a dose of 2 mg; IVth group – addition to the SS with citrate of Ni in a dose of 1 mg, Vth group – under similar conditions with the addition to the sugar syrup citrates of Co in a dose of 2 mg and Ni – 1 mg. The second series included seven groups of honey bees: control (I) – the group received 2 ml of 50 % SS per cage a day. Bees of IInd, IIIrd, IVth, Vth, VIth, and VIIth experimental groups, with SS, received a trace element, in different dilutions – (1: 3000); (1: 2000); (1: 1500); (1: 1000); (1: 700); (1: 500). The application of Co and Ni citrates in the spring period led to decrease content of Zn, Co (IInd and Vth), Cu, Mg (Vth), Se (IVth) in the tissues of the bee organism ($p < 0.001$ – $p < 0.01$) and the increase of Fe, Mg (IInd), Mn (IVth), which confirms the phenomenon of antagonism and synergism between these minerals. A probable increase content of Mg, Zn, Fe, Cu, Co and Ni in bee cells was established, with the highest indices of these mineral substances in the group receiving Ni citrate at a dose of 1.0 mg/0.3L/week/colony against the background of a decrease in the content of Se ($p < 0.001$ – $p < 0.01$). The biological effect of the Co and Ni citrates in bees was characterized by the improved nutritional value of honey and its preservation with increased proline content and concentration of hydrogen ions. Complex feeding of honey bees by citrates of microelements in high dilutions (1:3000; 1:2000; 1:1500 and 1:1000) with sugar syrup caused their corrective effect on mineral metabolism and increase ($p < 0.05$ – 0.02 ; $p < 0.01$ – 0.001) content of Co, Zn, Cu and Ni in homogenized tissues of the whole organism. It was established that in tissues of the organism of bees of the VIth–VIIth experimental groups that received the trace element complex in dilutions 1:700 and 1:500, there were like the directed reliable ($p < 0.02$ – 0.001) differences of the content of Co, Zn, Cu and Ni, however in the homogenized tissues of the whole organism of the bees VIth–VIIth of the experimental group was most deposited Ni, the level of which in tissues increased on 6.69 and 4.01 mg/kg; ($p < 0.001$) and Co (3.70 mg/kg; $p < 0.001$), but only in the homogenized tissues of the bees of the VIIth experimental group compared with the specimens of the tissues of the bees of the control group (Ist).

The conducted studies have shown that both separate and joint addition of citrates of trace elements to the honey bees in the spring period led to even-balanced changes in the content of certain mineral elements in their tissues. Activating the physiological capabilities of the honey bees by feeding organic salts of trace elements is a safe alternative that can be used to improve the viability and productivity of bee colonies in certain seasonal periods.

Keywords: honeybees, microelements, Co citrates, Ni citrates.

**DISTRIBUTION OF *GINKGO BILOBA* L. IN UKRAINE****Volodymyr Kravets, Angela Dzyba**National University of Life and Environmental Sciences of Ukraine
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Ginkgo biloba L. was considered to be an extinct species, only in 1691 it was discovered in Japan and described by E. Camping. In Japan, *Ginkgo biloba* became widespread from China in the Epochs of Kamakura and Muromachi (1192–1573), growing near temples as a decorative plant. In Europe, *Ginkgo biloba* began to spread from 1727 – Utrecht (the Netherlands), (the first cultivated tree was grown), 1930 – Geetbets (Belgium), 1750 – Anduze (France), Padova (Italy), 1758 – Slavkov (Czech Republic), 1762 – Kew (Great Britain), 1770 – Vienna (Austria), 1977 – Daruvar (Croatia), 1781 – Harbke (Germany), 1788 – Montpellier (France). In the 80^s of the XVIII century – North America.

The object of the study is *Ginkgo biloba* in the territory of the natural reserve fund of Polissya, Forest-Steppe, and Steppe (Ukraine). On the basis of the conducted inventory of *Ginkgo biloba* its distribution in Ukraine was analyzed.

In Ukraine for the first time *Ginkgo biloba* was cultivated in the Ternopil region (Kremenets Botanical Garden) in 1811; in 1818 – in the Crimean peninsula (Nikitsky botanical garden), 1819 – in the Kharkiv region (Krasnokutsky arboretum (imported from China)), 1847 – the Kyiv region (O.V. Fomin botanical garden, brought from Kremenets botanical garden), 1859 – the Zhytomyr region (park-memorial of landscape art «Park named after U. Gagarin»), 1894 – the Odessa region (botanical monument of nature "Square named after I.I. Mechnikov"). Since 1910 – *Ginkgo biloba* – is being planted in Sumy, Cherkassy, Vinnitsa, Poltava regions, mostly single specimens or groups of 2-3-5 plants.

Within Ukraine *Ginkgo biloba* is growing nowadays on the territory of 74 objects of the nature reserve fund (5 – Polissya, 47 – Forest-Steppe, 22 – Steppe) in almost all regions of Ukraine. *Ginkgo biloba* is most widespread in the park-monuments of landscape gardening (PMLG) of Forest-Steppe (26). A significant number – is growing in PMLG of Steppe (9), botanical monuments of nature (8) and arboretums (7) of the Forest-Steppe. *Ginkgo biloba* is represented in 11 botanical gardens (one – Polissya, 5 Forest-Steppe and 5 Steppe), where it is growing individually, in a group (3–5 specimens) and in an ordinary planting (the National Botanic Garden named after M.M. Grishko of the National Academy of Sciences of Ukraine), the age of plants does not exceed 200 years.

Ginkgo biloba was discovered in 18 regions, mostly represented in the Kyiv region (16 objects) and the Odessa region (10), in the regions of Cherkassy, Kharkiv and Poltava the number of objects of the natural reserve fund where *Ginkgo biloba* is growing ranges from 5 to 7, in other 13 regions *Ginkgo biloba* is uncommon and is growing in one or two objects.

Thus, for more than 200 years of its introduction in Ukraine, *Ginkgo biloba* was discovered only on the territory of Polissya, Forest-Steppe, and Steppe in 74 objects of the natural reserve fund, which are concentrated in 18 regions of Ukraine.

Keywords: *Ginkgo biloba* L., distribution, Ukraine, region.

Acknowledgments

The distribution of *Ginkgo biloba* L. in Ukraine on the territory of objects of the natural reserve fund is given.

SOCIO-ECONOMIC ASPECTS OF NON-TIMBER FOREST PRODUCTS' CERTIFICATION IN UKRAINE

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In the world, there is a significant demand for non-timber forest products (NTFPs), especially if they grow in aboriginal forest ecosystems, as these products are beneficial for human nutrition and health. In our time among buyers is a popular approach to the responsible consumption of forest products. There are various schemes for international forest certification, including the Forest Stewardship Council (FSC).

The aim of the study is to analyze the social and economic aspects that are reflected in the international forest certification requirements (FSC® scheme) in the part that is the newest for Ukrainian conditions – non-timber forest products (mainly food products).

The research materials were: the Criteria and Indicators that are reflected in NEPCon Non Timber Forest Product Certification Addendum for “NEPCon Interim Standard for Assessing Forest Management in Ukraine” (2019), as well as Verifiers from the final version of new National Forest Stewardship Standard (NFSS) of Ukraine, based on the FSC Principles and Criteria for Forest Stewardship V5-2. During the research, empirical research methods were used.

The Addendum consists of certification requirements (10 principles, 33 criteria and 68 indicators) for a number of non-timber forest products, namely Christmas trees, pine needle extract, mushrooms, berries, and birch syrup.

Between the national legislation of Ukraine and the FSC requirements, there are several excesses in terms of NTFPs requirements. In order to avoid excesses, forestry enterprises need to work with local communities to determine their complementarity in NTFPs marketing (receiving communities fair and adequate benefits for any use of their name or image). The use of local knowledge in cases where they are the basis for a patent for NTFPs is also relevant.

The latest requirement is the introduction of new technologies and practices in the process of NTFPs procurement, which should be carried out with due respect to traditional cultural norms. This issue should be solved taking into account the results of the assessment of the environmental impacts of the enterprise's economic activity on the state of the NTFPs' resources. Specific is the requirement for the use of saving methods of harvesting, in which NTFPs should remain in amounts that would be sufficient to preserve the ecological services of the forest, the viability of the populations of NTFPs. This can be achieved if the FMU conducts monitoring research. Attention is drawn to the need to take into account the ecological role and needs of target species of NTFPs and other related species (including birds and mammals) in the process of harvesting and management of the NTFPs' resources. Management Plan, which focuses on the procurement of NTFPs; Strategic plan; Financial and management plan; Results of monitoring; Survey of stakeholders; Documents on stakeholders engagement are important documents. Thanks to the adaptation of international requirements and conducted research, forestry enterprises of Ukraine will be able to certify NTFPs (according to FSC® scheme) and enter the world market.

Keywords: non-timber forest products, FSC.

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ANTIBIOFILM-FORMING ACTIVITY OF *VACCINIUM VITIS-IDAEA* L. LEAVES EXTRACT

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The continuously growing trend for the formation and circulation of antibiotic-resistant strains of opportunistic pathogenic microorganisms calls forth the topicality of studies in search of alternative means with antimicrobial properties. Development and introduction of new antibacterial materials and approaches to treatment and correction of inflammatory processes caused by opportunistic pathogenic microorganisms, and search for the antibacterial materials that may in a number of cases become an alternative to antibiotic treatment, also remains today an issue of primary importance. The ability of microorganisms to form biofilm creates the prerequisites for the development of chronic inflammatory processes. Under such conditions, search for alternative sources of antimicrobial activity becomes a particularly pressing issue. Plant products that combine antimicrobial activity with antioxidant, anti-inflammatory and deodorizing properties are a promising source for such components.

Genus *Vaccinium* L. includes around 450 species found mostly in the northern hemisphere of our planet. Fruit and leaves of these *Vaccinium* species produce a wide range of compounds: flavonoids such as anthocyanins, flavonols, flavanols (catechins), phenolic acids (benzoic and cinnamic acid derivatives), chromones, coumarins, lignans, iridoids, sterols, and triterpenoids. The principal components are flavonoids (anthocyanins). Extracts of anthocyanins from *Vaccinium* fruit and leaves demonstrate various pharmacological effects such as antidiabetic, anti-inflammatory, vasoprotective, antimicrobial, antitumor, gene-protective, and antioxidative

The purpose of the work was to study the antibiofilm-forming activity of ethanol leaves extract of cowberry (*Vaccinium vitis-idaea* L.), gathered in the Ukrainian Carpathians. From the leaves, ethyl extract was produced. The antibiofilm activity of the EO was tested in standard 96-well microtitration plates (Greiner-BioOne, Austria) using a modified staining method according to O' Toole (O'Toole, 2011). With the purpose of the study of the antibiofilm-forming activity, an 18-hour culture of the reference *S.aureus* CCM 3953 biofilm-forming strain grown at 37 °C was used.

We have shown the antibiofilm-forming activity of ethanol *Vaccinium vitis-idaea* leaves extract. It has been established that biofilm destruction by 67.6 % was registered even when affected with the lowest possible concentration of ethanol leaf extracts (0.01 %). The introduction of a higher concentration of extracts (0.05 %) caused biofilm destruction by 68 %; of a 0.1 % concentration – by 73.4 %.

In our preceding works (Kryvtsova et al., 2019), we showed that extract of cowberry fruit and leaves was established to possess a broad spectrum of antimicrobial activity against Gram-positive, Gram-negative microorganisms and *Candida* genus fungi. The study of antimicrobial, anti-biofilm forming, antioxidant and some biochemical properties let us ascertain that extracts of *Vaccinium vitis-idaea* leaves may exert high antimicrobial and anti-biofilm forming effect even upon polyantibiotic-resistant microorganism strains of skin and oral cavity.

Keywords: antibiofilm-forming activity, antimicrobial effect, *Vaccinium vitis-idaea* L.

Acknowledgment

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ANTIOXIDANT PROPERTIES OF DIFFERENT KINDS OF FODDER FOR FEEDING BEES

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An essential condition for ensuring the intensive development of bee families and increasing their strength is the provision of insects with a sufficient amount of high-quality fodders. In the winter-spring period, bee families often lack their own forage supplies, a large number of cells completely crystallized, especially on the honey flow of cruciferous and oil plants. Inadequate amount of feed-in bikes requires the use of feeding bees with high quality and biologically complete feed.

Antioxidant properties were determined to study the biological value of sugar-honey dough and honey syrup prepared on the basis of the centrifuge and capped sunflower honey.

The composition of sugar-honey dough was as follows: 81 % – sugar powder; 16 % – honey; 3 % – water. 80 % honey and 20 % of water were used to prepare honey syrup. Sunflower honey for research was obtained in the conditions of the Zhytomyr region of Ukraine.

The determination of the total antioxidant activity of the products was carried out using a photometric method with a high sensitivity to antiradicals at the laboratory of the Institute of Biodiversity Conservation and Biosafety at the Slovak University of Agriculture in Nitra. The results were processed and analyzed using Microsoft Office Excel 2010.

The obtained results of the research have shown that higher antioxidant properties are characteristic for feeding products made on the basis of capped honey. It was noted that the higher potential of the antioxidant activity of sugar-honey dough and honey syrup made of both centrifuges and capped honey was in water solutions. It was found that the antioxidant activity of sugar-honey dough was higher in the product made of capped sunflower honey. At the same time, its potential in water solution was 5.62 units, that by 2.45 units higher than in methanol solution. The use of capped honey for making a honey syrup has allowed obtaining the highest overall antioxidant activity of this fodder. The potential of the antioxidant activity of honey syrup with capped honey in a water solution was 9.54 units, which is by 2.93 units higher, compared with methanol solution.

Consequently, sugar-honey dough and honey syrup made of the centrifuge and capped sunflower honey show their antioxidant properties in both water and methanol solutions. However, we have noted that fodder products made of capped honey have a bigger biological value than of centrifuge honey. We can assume that this is due to a better biological activity of capped honey, compared with centrifugal one. Because capped honey contains a large number of organic acids, mineral compounds, vitamins, etc.

Keywords: antioxidant activity, sugar-honey dough, honey syrup, bee families.

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**BIOLOGICAL ACTIVITY OF JUJUBE FRUITS (*ZIZIPHUS JUJUBA* MILL.)**

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Ziziphus jujuba Mill. (jujube, Chinese date, Chinese jujube) is a species of *Ziziphus* Mill. in the Rhamnaceae Juss. has been cultivated from ancient time in China for the last 5000 years. Fruits, leaves, seeds and other parts of *Ziziphus jujuba* plant contain many important biologically active substances. Therefore, their physiotherapeutic effects are used to treat many diseases such as liver disease, fever, sore throat, pharyngitis, bronchitis, diabetes, skin infections, loss of appetite, diarrhea. It is also used for digestive disorders, weakness, urinary problems, and insomnia. It alleviates brain nerve disorders, regulates immune function and it's used to reduce blood triglycerides. It has anti-cancer, antifungal, antibacterial, anti-inflammatory, hypotonic, antioxidant and immunostimulatory properties. The fruits contain vitamin C, flavonoids, phenolic, amino acids, organic acids, polysaccharides, and microelements.

The aim of this work was to evaluate the biological activity of fruits of *Ziziphus jujuba* genotypes, as potential species for cultivation and use in Ukraine.

The objects of the research were 25-year-old plants of *Ziziphus jujuba* from seed origin, which are growing in Forest-Steppe of Ukraine in M.M. Gryshko National Botanical Garden of NAS of Ukraine (Kyiv).

The total antioxidant activity and the content of phenolic compounds and vitamin C in the fruits (fresh weight) of the *Ziziphus jujuba* of 9 genotypes were compared. The raw materials were collected in the season of full ripeness (October). Antioxidant activity (AOA) was measured using three different photometric methods (DPPH – 2,2-diphenyl-1-picrylhydrazyl, ABTS – 2,2-azino-bis-3-ethylbenzothiazoline-6-sulfonic acid, FRAP – ferric-reducing antioxidant power). Total polyphenol content (TPC) was evaluated using the Folin-Ciocalteu reagent assay. Content of vitamin C was determined by using the titrimetric method with 2,6-dichloroindophenol.

The results for AOA ($\mu\text{mol Trolox/g}$) determined by the DPPH method varied from 7.30 ± 0.54 to 30.52 ± 0.68 , those obtained by the ABTS method varied from 19.65 ± 0.30 to 59.29 ± 3.87 , and those obtained by the FRAP method varied from 9.04 ± 0.96 to 24.33 ± 2.18 . The results for TPC varied from 580.97 ± 23.66 to 758.92 ± 16.59 mg/100 g. Vitamin C content ranged from 212.71 ± 8.58 to 626.50 ± 3.62 mg/100 g. A positive linear correlation was found between antioxidant activity and total polyphenol content and vitamin C in the examined plant material.

The results showed that all fruit extracts exhibited strong antioxidant activities, which generally correlated positively with the total polyphenol content and vitamin C and demonstrates the potential of the fruits as a possible source of valuable polyphenol content and vitamin C, with high antioxidant activities and health-promoting properties.

Keywords: *Ziziphus jujuba*, fruits, antioxidant activity, polyphenol content, vitamin C.

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BIOLOGICAL AVAILABILITY OF ZINC, IRON AND MANGANESE IN THE *TRITICUM DICOCCON* (SCHRANK) SCHÜBL. GRAIN**Elena Kuznetsova¹, Gunesh Nasrullaeva², Elena Kuznetsova¹**¹Orel State University named after I.S. Turgenev, Orel, Russian Federation;

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Organic products are very popular in many countries around the world. To create such products, it is proposed to use the grain of an undeservedly forgotten type of wheat *Triticum dicoccon* (Schrank) Schübl. It is known that spelled grain contains more minerals than traditional types of wheat. The purpose of this study was to study the content of Zn, Fe, and Mn in the wheat grain *Triticum dicoccon* and the biological availability of chemical elements.

The object of the study is the grain *Triticum dicoccon* var. Dicoccon selected on the Absheron Peninsula in the Republic of Azerbaijan in 2018. The determination of the mineral composition of the grain was carried out after dry ashing of samples by the atomic absorption method on a Hitachi-180-80 instrument. Bioavailability was judged by the accumulation of chemical elements in the indicator organ of animals – the liver.

It was established that the content of mineral elements in the *Triticum dicoccon* grain is Zn – 18.2, Fe – 44.8, Mn – 28.5 mg/kg. Dense multilayer shells and a high concentration of phytic acid were found in the *Triticum dicoccon* grain, compared with traditional raw materials for the production of grain food products. Phytic acid with mineral elements forms phytates, reducing the availability of nutrients. To modify the structure of the dense shells of grain and increase the availability of mineral compounds at the stage of soaking the grains, an enzyme preparation based on phytase F 4.2B, produced by *Penicillium canescens*, was used. The composition of the enzyme preparation includes a complex of enzymes: cellobiohydrolase, β -glucanase, xylanase, and phytase. To maintain the pH of the medium 4.5 used citrate buffer. The rational dose of the drug was established experimentally and amounted to 0.12 % by weight of the dry substances of the grain, the duration of soaking was 10 hours at a temperature of 50 °C. After fermentation, the grain was washed with water for 10 minutes. Then, the feeding of *Triticum dicoccon* grain in the composition of the main diet to clinically healthy male Wistar rats was performed for a month. Animals were kept in vivarium conditions in accordance with the principles of good laboratory practice GLP in conditions controlled by temperature, humidity, light, and bacterial purity. After a two-week quarantine with the permission of the veterinarian, the animals were randomized into 4 groups (n = 5 in the group). The first group acted as a control — received non-fermented grain *Triticum dicoccon*, the second group received fermented grain. The organs of experimental animals on the content of mineral elements in them were studied. The control rats liver contained Zn 23.8, Fe 84.9, Mn 0.74 mg/kg, in the liver of experimental animals – Zn 34.4, Fe 95.2, Mn 0.85 mg/kg.

The results show that the fermentation of grain contributed to an increase in the bioavailability of the studied mineral elements. Therefore, this process should be carried out for the preparation of *Triticum dicoccon* grains in the production of cereal food products in order to increase their nutritional value.

Keywords: *Triticum dicoccon*, grain, zinc, iron, manganese, bioavailability.

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CULTIVATION OF TOBACCO PLANTS EXPRESSING *desC* AND *desA* GENES OF DESATURASE CYANOBACTERIA IN CONDITIONS OF OSMOTIC STRESSES

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The study of the adaptation of plants to abiotic stress is one of the most promising directions today. One of the mechanisms to increase the resistance of plants to the influence of temperatures (high, low, frost), lack of moisture, the influence of wind, salinity of soils is an increase in the proportion of unsaturated fatty acids in the lipids of membrane. With the increase in the proportion of unsaturated fatty acids in the membrane lipids, the viscosity of the membranes increases, and resistance to abiotic stresses increases.

Desaturases are enzymes that promote the formation of double bonds in fatty acids and thus convert them from saturated to unsaturated. Cyanobacteria are among the ancient organisms that have not been mutated for the last two million years. Which points to high adaptability. The *desC* gene encoding the $\Delta 9$ -acyl-lipid desaturase of cyanobacteria *Synechococcus vulcanus* and the *desA* gene encoding $\Delta 12$ -acyl-lipid desaturase of cyanobacteria *Synechocystis sp.* PCC 6803 was used in the work.

By genetic *Agrobacterium tumefaciens*-mediated transformation, *Nicotiana tabacum* tobacco plants that simultaneously express the *desC* and *desA* genes were obtained. Plants were planted on a medium of MS with the addition of mannitol (concentration 100 mM 200 mM) for further work. The parameters of malondialdehyde, the superoxide dismutase enzyme, and the level of gene expression on the activity of the reporter protein were checked. Wild-type tobacco plants and transgenic plants that have in their genome expressing the *gfp::licBM3* gene are used as controls.

Malondialdehyde is a marker of oxidative degradation of unsaturated fatty acids. The mechanism of action of SOD consists in the successive restoration and oxidation of superoxide anionic radicals of the metal of the active center of the enzyme. The activity of SOD is carefully studied since this enzyme plays an important role in protecting cells and tissues from oxidative degradation. Since the desaturase genes are in the frame of reading from the genome of the reporter protein of the thermostable lichenase, the activity of the thermostable lichenase after the cultivation of the plants on MS medium and MS with the addition of mannitol is checked.

It was found that the highest level of activity of thermostable lichenase was in plants with desaturase genes, indicating increased expression of desaturase genes. Most damages were detected in plants with the gen *gfp::licBM3*. Less degenerative changes have been found in plants containing in their genome and expressing genes of desaturase of cyanobacteria.

Keywords: abiotic stress, desaturase.

CHARACTERIZATION OF BACTERIAL ENDOPHYTES OF AMARANTHUS CULTIVARS BY NEW GENERATION SEQUENCING TECHNOLOGY

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Endophytic bacteria are a natural part of plant tissues and are revealed to be important for different functions in plants that lead to the production characteristics of them as well as the plant health background. The analysis of intracellular bacterial variability has been broadening in the last years by the methods of a high throughput sequencing approach that provide new insights to the large ecodiversity that bacteria possess. The metagenomic analysis is one of the very modern approaches used for microbial communities study. Here, metagenomic sequencing was used to the preliminary characterization of two *Amaranthus* cultivars – Pribina and Zobor. Endogenous metagenomic profiles of bacterial populations of wheat cultivars and amaranth genotypes were obtained by NGS (MiSeq) technology.

Young leaves were collected and surface sterilized. DNA was extracted using the GeneJet™ Plant Genomic Extraction Kit (Thermo Scientific) following the manufacturer instruction. The amplification of approximately 500 bp long conserved regions of 16S rRNA genes was performed by PCR using the universal bacterial primers that were modified for the purposes of using them in the Illumina NextSeq sequencer. Nextera® XT Index Kit was used to add the dual index barcodes to the amplicons. The sequencing procedure was performed on Illumina MiSeq using MiSeq Kit V3 600 cycles kit with pair-end 300 bp sequencing

The presence of the genera *Endobacter* sp., *Dichotomicrobium* sp., *Burkholderia* sp. In Pribina cultivar was obtained and cultivar Zobor was characterized by the presence of propagated halophilic bacteria (genus *Limimonas* spp.), culminating thermophilic bacteria (genera *Oceanotoga* spp. and *Orientia* spp.), and receded acidophilic bacteria (genera *Endobacter* spp. and *Abiotrophia* spp.).

Our study revealed for the first time the endophytic bacteria analysis in amaranth Pribina and Zobor cultivars using the Illumina sequencing protocol.

Keywords: *Amaranthus*, Pribina, Zobor, metagenomics.

Acknowledgement

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METHODOLOGICAL APPROACH TO THE ASSESSMENT OF HAZELNUT CULTIVARS POLLEN PRODUCTIVITY

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The sufficient amount of the pollen is the main condition for successful cross-pollination on hazelnut plantations and obtaining stable and abundant yields. The hazelnut cultivars are usually assessed by yield, nuts quality, and winter resistance, while their ability to produce the pollen is often overlooked. In our previous investigations (Sitnik, Los, 1989; Los, 2007), the evaluation of hazelnut varieties as pollinators was carried out by indicators of the catkin formation intensity and winter resistance. Jetschni and Jochner-Oette (2019) have used the indicator 'pollen production' for hazelnut, which characterizes the number of pollen grains from the plant. At the same time, the indicator 'pollen productivity', which characterizes the mass of pollen from one plant (Pel'menyova, Rudninskaya, 1975), is often used to characterize the agricultural plants. The study aimed to develop a simple and accessible methodological approach to assess the pollen productivity of hazelnut cultivars.

The research was carried out in 2019 at the hazelnut collection orchard established in 1988, where the best cultivars by URIFFM breeding (F. Pavlenko) were represented. The catkins of 13 cultivars were collected in three terms ((1) the catkin elongation beginning, (2) the maximum catkin elongation, (3) the beginning of the pollen flying). Catkins (20–30 pcs.) were placed in paper bags or plastic cups and dried at room temperature (+18–20 °C) or in a thermostat (+ 25 °C). After drying and separation the pollen, they were weighed on electronic scales and pollen output from one catkin (the weight of pollen from one catkin, g) was determined.

The pollen productivity (Pp) was determined as the pollen output from one plant according to the formula: $Pp = Po * Nc * Nb$, where Po – the pollen output from one catkin (g), Nc – the average number of catkins on the skeletal branch and Nb – the estimated number of branches in the shrub. The estimated number of branches was assumed to be 10 (Recommendations for the establishment of industrial plantations of nut-bearing plants in Ukraine, 1985).

A comparison of pollen output from one catkin of the samples collected in different terms allowed us to conclude that they should be harvested during the period of the maximum catkin elongation but before the pollen flight beginning. Harvesting in other terms has led to a decrease in pollen output. The values of pollen output from one catkin of the same cultivars were similar at different temperatures of drying. The samples are more conveniently to dry in the plastic cups.

The average pollen output from one catkin of the studied cultivars was 0.033 g. The values for the cultivars varied from 0.012 (Lozovsky sharovidny) to 0.045 g (Dnipro-1). Pollen productivity of the entire plant was ranged from 40.2 (Podarunok yunatam) to 210.9 g (Dar Pavlenka). Cultivars Dnipro-1, Kharkiv-3, and Badius can produce at least about 100 g of pollen, and Podarunok yunatam, Lozovsky sharovidny, and Davydovsky can produce less than 50 g. So according to the preliminary data, the best pollinators are the cultivars Dar Pavlenka, Dnipro-1, Kharkiv-3, and Badius.

Significantly higher dependences of the pollen output from the plant on the number of catkins in the bunch ($r = 0.62$) and on the pollen output from one catkin ($r = 0.51$) than on the number of catkin bunches on the shrub ($r = 0.12$) were detected.

Keywords: hazelnut, pollen, catkins, pollen mass, pollen productivity.

'GREEN' SYNTHESIS OF HUMAN INTERFERON- α 2B IN 'HAIRY ROOT' CULTURE OF *ARTEMISIA TILESII* PLANTS

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Agrobacterium rhizogenes – mediated transformation of plants is the method for foreign genes transferring to plant genome. This process results in “hairy” roots formation and is a way to change plant genome since bacterial cells can carry not only its own Ri-plasmid but also plasmids with a wide range of target genes including mammalian origin genes. Study of the possibility of human interferon- α 2b *ifn- α 2b* gene transfer and synthesis of the protein in *Artemisia tilesii* Ledeb. “hairy” root cultures was the aim of the work.

Artemisia tilesii “hairy” root cultures were obtained using the transformation by *A. rhizogenes* A4 carried pCB124 and pCB161 plasmids with human *ifn- α 2b* gene (35S and Mll promoters respectively). Roots were subcultured on the agar-solidified ½ MS medium (20 g/L sucrose, pH 5.7). Polymerase chain reaction combined with reverse transcription (RT-PCR) was performed to study the transcription of transferred *ifn- α 2b* gene in transformed root lines. Antiviral activity of the extracts was determined using a micro method to reduce the cytopathic effect of vesicular stomatitis virus Indiana strain (VSV) in the MDBK kidney bovine cells highly sensitive to the antiviral effect of human IFN-alpha. The international standard interferon-alpha (2nd WHO International Standard 1999 Human Interferon alpha 2b, rDNA *E. coli* derived 95/566, 70000 IU per ampoule) was used as a standard in the investigation.

Extracts from the control roots (the plants were cultivated in *in vitro* conditions) did not inhibit VSV. RT-PCR analysis demonstrated the presence of mRNA in all samples of “hairy” roots studied. At the same time, the differences in the level of antiviral activity of the extracts from some “hairy” root lines were founded. For example, the antiviral activity of extracts from transgenic roots obtained using vector pCB124 with human *ifn- α 2b* gene under the control of 35S cauliflower mosaic virus promoter significantly exceeded the activity of the extracts from transgenic roots obtained by the transformation using pSB161 vector with human *ifn- α 2b* gene under the control of Mll promoter. It must be noted that in the extract of one line, despite the presence of mRNA according to RT-PCR analysis, there was no activity against VSV. It may be due to problems in the translation process, post-translational changes or because of a very small amount of the protein synthesized in the root cells. Analysis of antiviral activity revealed that extracts from the “hairy” root lines (vector pCB124) possessed antiviral activity against VSV within 652 ... 98437 IU / g wet weight or 0.2 ... 28.0 IU / mg of total soluble protein.

So, the high antiviral activity founded in the extracts of *A. tilesii* transgenic roots indicates a great biotechnological potential of these plants.

Keywords: *Artemisia tilesii* Ledeb., “hairy” root culture, human interferon- α 2b, antiviral activity.



PLANT GENETIC RESOURCES INFORMATION SYSTEM OF SLOVAKIA AS THE PRIMARY SOURCE OF INFORMATION

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GRISS is a new plant germplasm protection information system (IS) that will replace the current EVIGEN off-line documentation system used since the opening of Gene Bank in 1996. IS GRISS is fully compatible with the passport descriptors standards of FAO/Bioversity Multicrop Passport Descriptors (MCPD v.2.1). GRISS is determined to comprehensive management of accessions of plant genetic resources stored in the National Agricultural and Food Centre, Research Institute of Plant Production in Piešťany in the Gene Bank in accordance with international principles and in accordance with the National Programme. IS GRISS presents the platform for information about *ex situ* plant collections maintained in Slovak republic. GRISS allows users to search and obtain information about a number of crop species such as cereals, legumes, fodder crop, medicinal and aromatic plants, wild species, landraces and breeding lines. IS GRISS allows search by crop, taxonomy, country of origin, acquisition, accessions status and other passport descriptors. The collected germplasm is freely available for use in scientific research programs. IS GRISS provides access to information not only the managers of gene banks but also provides information's to others curators of collections, scientists, breeders, farmers, students and the general public responses. The information system GRISS is freely accessible at web portal <http://griss.vurv.sk>.

IS GRISS allows curators of collections of plant genetic resources automated support for all activities related to the creation and management of passport data and characterization/evaluation data. IS GRISS is designed as a web application that provides a sophisticated web interface for simple data input via a web browser. It enables effective management of the collections. IS GRISS was built as an open system and modular scalable system. The modular system architecture allows its future expansion with additional subsystems such as barcode, image analysis and geographic information systems (GIS).

Thanks to the new IS GRISS for PGR data documentation mainly good interconnection of all three main working areas: passport, characterization/evaluation and storage parts and profiting from the construction of descriptor lists published by Bioversity. The main effect of the new IS GRISS is overall increase in the quality of documentation of plant genetic resources in the Slovak Republic, where the curators of the new system enable more effective management of PGR collections as well as significantly improve the efficiency of selecting the most suitable resources for the specified use (breeding or experimental material etc.). The system also facilitates getting information about PGR and also enabled online orders of PGR provided from the gene bank for home and foreign users. At international level has improved compatibility with other documentation systems and international data exchange, mainly for EURISCO.

Keywords: plant genetic resources, accessions, information system, GRISS, web application, passport data, evaluation data.

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ANTIOXIDANT ACTIVITY OF AROMATIC HERBS FROM BOTANICAL GARDEN OF THE SLOVAK UNIVERSITY OF AGRICULTURE IN NITRA

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Biological activity of plant raw is an actual topic in modern biological science. Study of antioxidant activity of plants the most discussed direction in scientific references.

Plant material of this study was *Hyssopus officinalis* L., *Lavandula angustifolia* Mill., *Nepeta kokanica* (Regel) Kuntze, *Rosmarinus officinalis* L., *Salvia officinalis* L., *Thymus serpyllum* L., and *Th. vulgaris* L. harvested from the collection of Botanical Garden of Slovak University in Nitra at the period of flowering. It was determined total content of polyphenols (gallic acid equivalent (GAE)), flavonoids (quercetin equivalent (QE)), phenolic acids (caffeic acid equivalent (CAE)), antioxidant activity (Trolox equivalent (TE)) and reducing power (TE) of extracts. All measurements carried out on the spectrophotometer Jenway (6405 UV/Vis, England).

In our study total content of polyphenols among investigated plant extracts was from 39.43 to 62.87 mg GAE/g of DW (dry weight) and increased in the following order: *L. angustifolia* > *Th. serpyllum* > *H. officinalis* > *R. officinalis* > *N. kokanica* > *Th. vulgaris* > *S. officinalis*. The content of flavonoids was from 20.80 to 36.80 mg QE/g of DW and increased in the following order: *Th. serpyllum* > *L. angustifolia* > *H. officinalis* > *Th. vulgaris* > *N. kokanica* > *R. officinalis* > *S. officinalis*. Content of phenolic acids of alcohol extracts was from 4.91 to 24.30 mg CAE/g of DW and increased in next order: *N. kokanica* > *R. officinalis* > *L. angustifolia* > *H. officinalis* > *Th. serpyllum* > *Th. vulgaris* > *S. officinalis*. Antioxidant activity by DPPH-method was from 7.78 to 8.50 mg TE/g of DW and increased in the following order: *S. officinalis* > *L. angustifolia* > *R. officinalis* > *Th. serpyllum* > *N. kokanica* > *Th. vulgaris* > *H. officinalis*. Reducing power of investigated extracts was from 122.92 to 225.36 mg TE/g of DW and increased in the following order: *N. kokanica* > *Th. serpyllum* > *Th. vulgaris* > *L. angustifolia* > *S. officinalis* > *H. officinalis*.

Thus, we found that among investigated plants *S. officinalis* extracts had the highest amount of polyphenol compounds, phenolic acids, and flavonoids. Antioxidant activity and reducing power was maximal for plants of *H. officinalis*. All investigated plants are a potential source of natural antioxidants and have potential as therapeutic agents.

Keywords: aromatic herbs, antioxidant activity, polyphenols.

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**ANTIOXIDANT ACTIVITY OF FRUITS EXTRACTS OF *CAPSICUM* L. CULTIVARS**

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Species of *Capsicum* L. genus are widely used by the human and known by their food value, health-promoting properties and has cultivated in many countries (India, China, Japan, Vietnam, Mexica, countries of Africa, South and Middle America, etc.).

Collection of chili peppers in the Botanical Garden of Slovak University of Agriculture in Nitra created in 2017 and represented by 60 cultivars. In 2018 the collection contained 100 samples. 'Caroline Reaper' (*C. chinense*) one of the most impressive cultivar, which was registered in the Guinness Book of Records. There are many interesting cultivars among which 'Aji Charapita' that is added to soups. One kilogram of this spice has cost 35 000 dollars. The spices has strong fruit aroma and is an ingredient of souses (as powder).

In this research represented results of study of antioxidant capacity of selected cultivars of *Capsicum* species (*Capsicum annum* L., *C. baccatum* L., *C. chinense* Jacq.) from experimental collection of Botanical Garden of Slovak Agricultural University in Nitra. For experiment chosen 28 samples and dried at the 35 °C for 36 hours. Crushed samples (200 mg) extracted in 20 ml of 80 % ethanol for 2 hours at the constant stirring. After filtration obtained extracts used to determine total content of polyphenols (TCP), total content of phenolic acids (TCPA), total content of flavonoids (TCF). Antioxidant activity determined by both DPPH scavenging activity (DPPH) and reducing power of extracts (RP).

Obtained data demonstrated that TCP was in range from 10.13 (*C. baccatum*, Aji Fantasy Sparkly White) to 38.69 (*C. baccatum*, Habanero Red Savina) mg GAE/g DW, TCPA was in range from 2.24 (*C. baccatum*, Aji Fantasy Sparkly White) to 13.71 (*C. chinense*, Fatalii Red) mg CAE/g DW, flavonoids from 5.73 (*C. baccatum*, Aji Fantasy Sparkly White) to 27.32 (*C. baccatum*, Habanero Red Savina) mg QE/g DW. Antioxidant activity by DPPH method was from 1.45 (*C. chinense*, Habanero Chocolate) to 8.21 (*C. chinense*, Fidalgo Roxa) mg TE/g DW and reducing power of extracts had values from 24.81 (*C. annum*, Black Prince) to 198.21 (*C. baccatum*, Habanero Red Savina) mg TE/g DW.

This study demonstrated that varieties of *Capsicum annum*, *C. baccatum*, *C. chinense* are a valuable source of antioxidants of phenolic nature. They have significantly different values of phenolic compounds and their antioxidant activity. Results of research support the use of different investigated cultivars for functional food production and pharmacology.

Keywords: chili peppers, antioxidant activity, polyphenols.

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This study was financially supported by scholarships from International Visegrad Fund (51810415), National Scholarship Programme of the Slovak Republic and Polish National Commission for UNESCO. This study also conducted within the framework of AgroBioNet.



STUDY OF MINERAL COMPOSITION IN THE LEAVES OF *AMARANTUS* L.

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In photosynthetic organisms, the accumulation of calcium oxalate crystals at high levels is a normal activity tightly integrated with metabolism. The huge variation in distribution among organs, tissues, and cells among plant species suggests multiple independent origins of crystal formation and its functions. Despite their ubiquity, knowledge on the formation and the possible role of these crystals remains limited. Calcium oxalate crystals are a major biomineralization product in higher plants. Their biological function and use are not well understood. In this work, we focus on the isolation and crystallochemical characterization of calcium oxalate crystals in the leaves of *Amarantus* – is an annual plant.

The objects of research are the leaves *Amaranthus tricolor* L. breeds by Federal center of vegetable production selection (Moscow region, Odintsovo). The plants were grown in the open on the experimental fields, leaves samples for analysis were collected. The determination data of quantitative elemental composition, presented in this paper, are fulfilled in the laboratory of electronic microscopy of FSBSI ARHIBAN Plants genofund and bioresources center, Moscow.

The anatomical features and chemical composition of the inclusions was studied by EDS, combined with an analytical scanning electron microscope JEOL JSM 6090 LA. On the transverse sections of the amaranth leaves and in the veins of the leaf, multiple crystals of circular shape were found.

Symmetric protrusions of crystals are viewed on the SEM image of the abaxial and adaxial sides of the leaves *Amarantus* L.

EDS analysis revealed 4 elements in the crystal – Mg (0.25), P (0.48), K (0.16) and Ca (38.59) mass%.

The distribution of Mg, P, K, Ca in the mineral inclusions. All elements were clearly observed and mapped using Smiling program. X-ray images which mapped all elements location K, P and Mg show that are distributed uniformly around of the mineral inclusions. Ca is concentrated in the crystal. The SEM / EDX results are allowed to determine the concentration and distribution of elements in the mineral inclusions in the leaves *Amarantus*. The crystal cells or idioblasts display ultrastructural modifications which are related to crystal precipitation.

The combination of SEM and EDX was a convenient method for determining the mineral inclusions in the cross-section leaves *Amarantus*. It was found that Ca is localized in the granule. Probably the crystals perform a supporting function in the sheet structure.

Keywords: *Amaranthus tricolor*, leaves, analytical scanning electron microscopy.



**ABOUT THE NUTRITIONAL VALUE OF THE FRUITS OF
ACTINIDIA KOLOMIKTA (MAXIM. & RUPR.) MAXIM.**

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The fruits of actinidia are new fruits on the market and are in increasing demand from consumers all over the world. In this regard, it is important to identify the benefits of the fruits of actinidia for human health.

The purpose of the study was a comparative study of cultivars of *Actinidia kolomikta* in the content of soluble solids in the fruits, antioxidant activity, gallic, chlorogenic acids, ash composition and the presence of low molecular weight metabolites.

The objects of research were 10 cultivars from the collection of *Actinidia kolomikta* (Maxim. & Rupr.) Maxim. (FSTU): Vinogradnaya, Dolgovechnaya, Nadezhda, Pamyati Kolbasinoy, Prazdnichnaya, Prelesestnaya, Sestra, Uslada, Chempion, Ella. The studies were performed using the following methods: refractometric, spectrophotometric, chromatographic (high-performance liquid chromatography HPLC, gas chromatographic mass spectrometry-GHMS) and energy dispersive (EMF analysis).

The content of soluble solids in the fruits of *Actinidia kolomikta* ranged from 12.6 (cv. Vinogradnaya,) to 19.9 % (cv. Sestra). Antioxidant activity of alcoholic extracts is 1.3–2.2 times higher than water. The minimum antioxidant was found in the Nadezhda cultivar (89.5 and 40.2 %), the maximum in the Pamyati Kolbasinoy cultivar (93.1 and 73.3 %) alcohol and aqueous extracts, respectively. The content of gallic acid in the test samples did not exceed 0.01 mg/%; chlorogenic acid content is on average 2.3 times higher than gallic. The ash composition is represented by 12 elements, the series of which decreases is: $K \approx Ca > P \approx Mg > Mo > S > Se > Zn \approx Si > Co \approx Fe > Na$. The content of elements in the ash is: K and Ca – 10.1–23.5; P and Mg – 1.1–5.5; Mo – 0.4–1.8; S – 0.3–0.9; Se – 0.2–0.4; the share of the remaining elements does not exceed 0.015 mass%, respectively.

In water extracts from fresh fruits using the NIST spectra database 36 low molecular weight metabolites were identified: 8 organic acids (ascorbic, malic, citric and isolimone, valeric, dodecanedicarboxylic, ribonic, tartaric); 7 substances of phenolic nature – benzoic acid, phenylacetic acid, natural phenolic antioxidant Tirozol, phthalic acid, anisic acid, cinnamic acid, myo-inositol; 6 sugars – glucose, mannose, xylose, ribose, tagatose, sorbitol; 6 furanose and pyranose forms of monosaccharides – ribofuranoside, fructofuranoside, glucofuranoside, xylopyranose, tagatofuranose, thalopyranose; 7 organic acids that make up the oils – lauric, myristic, pentadecanoic, palmitic, octadecanoic, linoleic, stearic; 2 amino acids – l-alanine and betaine (a derivative of glycine).

All substances found by us limit the nutritional value of the fruits of *Actinidia kolomikta*. Our research convincingly shows that the fruits of the cultivars of the uncommon culture of *Actinidia kolomikta*, cultivated in the conditions of the Moscow region, are an excellent component of the composition of dietary functional foods.

Keywords: *Actinidia kolomikta*, fruits, biochemical composition.

HEALTH STATE AND STABILITY OF TREES IN URBAN GREENERY

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Due to the safety of residents as well as the preservation of trees in urban greenery for their social, aesthetic, cultural, and biological value, the great effort is being laid on evaluation of health state and stability of trees. Visual assessment still persists as a key approach to determine the health state of trees. For purposes of tree stability evaluation, visual as well as instrumental diagnostic methods based on physical and physiological parameters measurements are being used.

Among serious global environmental problems, pollinators, especially bees, are endangered for various reasons. Pollinators play an irreplaceable role in plant pollination. Among trees, planted in urban greenery, interesting genera for production of honey and pollen by bees are *Salix*, *Gleditsia*, *Robinia*, *Aesculus*, *Tilia*, *Acer* and *Sophora*. Production of honey from mentioned genera can reach from 10 to 1.200 kg/ha and production of pollen can reach 40 to 216 kg/ha.

In our research, we evaluated trees, planted in urban greenery, visually assessed as wounded and recommended for instrumental assessment of stability using acoustic tomography. Principle of acoustic tomography of trees lays in sound velocity measurement in a tree trunk, where the velocity of sound wood is higher compared to decayed wood. High precision tomogram of the internal structure of wood is being achieved.

We evaluated 1.176 trees of 38 genera from approx. 50 localities in Slovakia. Among all assessed trees, 53.91 % of trees are attractive for bees. Among them, there were 294 trees of genus *Tilia*, 131 trees of *Aesculus* and 104 trees of *Acer*.

In our research, we determined tree stability index, trees of genus *Sophora* reached the highest index of 1.14, trees of *Tilia* 1.17 and lowest index of 1.56 was determined on *Aesculus*. Tree stability assessment, based on computed risk factor (RF) was also determined. Lowest stability (<100 % RF) was detected on 4.4 % of trees, recommended on immediate felling. 23.5 % of trees were assessed as danger (<150 % RF). All other assessed trees (72.1 %) were determined as stable (>150 % RF), even in spite of detected decay of other structural defects.

Based on our research experience, we consider acoustic tomograph Fakopp 3D as a reliable instrument for overall tree stability evaluation, which allows gaining a brief and precise determination of internal trunk structure as well as objective tree stability computation.

Keywords: FAKOPP 3D, acoustic tomography, tree health, tree stability, tree stability index.

**ALIMENTARY AND BIOACTIVE POTENTIAL OF FRUIT NON-TRADITIONAL CULTURES****Olena Palamarchuk¹, Nadiya Dzhurenko¹, Violeta Todorova²**¹M.M. Gryshko National Botanical Garden of the National Academy of Sciences of Ukraine Kyiv, Ukraine; E-mail.: pastinacase@gmail.com;²P.L. Shupyk National Medical Academy of Postgraduate Education

In the complex of effective measures of human organism adaptation for the environment, as a prophylactic, and therapeutic purposes need adequate intake of bioactive natural products that can not only provide the body with energy but also compensate the deficit of essential nutrients correctors of the disturbed link of metabolism. The utmost importance of products of a functional orientation with the increased interest in non-traditional fruit crops that had enriched with indispensable bioactive balanced ingredients with antioxidant, adaptive and detoxifying effect. Natural conditions of Ukraine cause a strongly pronounced seasonality of consumption of fruit *Morus alba* L., *Aronia mitschurinii* A.K. Skvortsov & Maitul, *Hippophae rhamnoides* L. Their taste, nutritional value, therapeutic and prophylactic significance have identified the problem of extending their shelf life for a year-round diet. The aim of the work was to study the biochemical features of the fruits of the species and the assessment of the influence of low-temperature technologies on the safety of their quality indicators.

Used in phytochemical complex conventional methods of chromatographic, spectral and photolorimetry, permanganometry, titrimetry, statistics, etc. Freezing fresh fruit (in packages) – in the low-temperature cupboard: in a quick cold shock (-20°) and long (6 months) cold storage conditions (-10°). This is one of the affordable and effective ways of preserving the products of the complex of valuable substances when the participation of oxidative enzymes is blocked and the destructive effect of microorganisms is stopped.

Phytochemical analysis of the fruit indicates a high (8.8 *A. mitschurinii*, 16.8 *M. alba*, 10.0–17.5 *H. rhamnoides*) content (%) monosaccharides, with the advantage of glucose and fructose, which determine their nutritional value, their level increases after freezing; when stored for 6 months the smallest losses in the share of sugars were distinguished by the fruits of *M. alba* (<1%); to 12.2–19.5 mg% β -carotene in *H. rhamnoides* and 1.62–2.70 mg% in the fruits of *A. mitschurinii*; the presence of organic acids (%): 1.4 (*M. alba*), 3.0 (*A. mitschurinii*), 1.8–3.2 (*H. rhamnoides*) with focus on an apple acid; P-vitamin substances (mg%) is dominated by (67.9) in the fruits of *A. mitschurinii* (with high levels of anthocyanins 156.7–288.0) and significantly accumulate in the fruit superior to the fruits of *H. rhamnoides* (32.5–65.0) and of *M. alba* (35.6–47.8). Fruit are valuable (mg%) with vitamins C: 30.8–110.4 (*H. rhamnoides*), 15.9–26.4 (*A. mitschurinii*), 12.8–22.1 (*M. alba*) and minerals (mg%): for *A. mitschurinii* Fe 148.0; K 27.0; Ca 8.0; Na 7.8; for *M. alba* Ca 5.6; K 15.4; Na 3.8; Si 3.3 and for *H. rhamnoides* Fe 43.2; K 21.1; Ca 6.5; Mg 2.6. Accumulation (%) of pectins and tannins to *A. mitschurinii*, *M. alba* and *H. rhamnoides* is 0.7 and 0.6; 0.6 and 0.1 and also 1.1 and 0.9 respectively. t° shock provoked a reduction of these parameters and vitamin C, however, during storage, the level of pectin was increased by 1.1 % for all species; vitamin C especially for *M. alba* to 25 mg%. Low-temperature technological methods allow maximum preservation in fruits of high content of native bioactive ingredients with their nutritional and pharmacological value.

Keywords: *Morus alba*, *Aronia mitschurinii*, *Hippophae rhamnoides*, cold preservation of fruits.



ALLELOCHEMICALS FROM *CASTANEA SATIVA* MILL.: PLANT-ROOT ENVIRONMENT INTERACTIONS

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Sweet chestnut (*Castanea sativa* Mill., Fagaceae family) is a valuable food, ornamental, honey and medicinal plant. *C. sativa* grows in nature mainly in the Mediterranean and Atlantic regions of Europe, Asia Minor, and North Africa. *C. sativa* is spread in Ukraine predominantly in the Precarpathian and Transcarpathian regions. Recently, the economic efficiency of using of *C. sativa* in natural habitats significantly reduced as a result of damage from pests and diseases, and the effects of global climate change. Therefore, it is extremely important to cultivate *C. sativa* outside the natural range to preserve its gene pool. The success of the introduction of new plant species to a large extent depends on the allelopathic factor. The purpose of the work was to investigate the allelopathic properties of the root environment of *C. sativa* plants of different ages under the conditions of introduction.

The objects of the research were 10 and 40-year-old plants of *C. sativa*, which are growing in Forest-Steppe of Ukraine in M.M. Gryshko National Botanical Garden of National Academy of Sciences of Ukraine (Kyiv). Rhizosphere soil samples were collected at 0–30 cm layer. The fallow soil was used as a control. Allelopathic and biochemical analyses of the root environment of *C. sativa* were conducted in dynamics during the growing season. Allelopathic activity of the root environment was studied by direct bioassay method. The redox potential (Eh) was measured in soil suspension modelling soil solution at the soil to distilled water ratio as 1:1 by potentiometric technique. Phenolic compounds were extracted from the soil by desorption method using an ion exchanger KU-2-8 (H⁺).

Allelopathic analysis of the root environment of chestnut plants showed phytotoxicity within the range of 19.9–61.9 % compared with control. Phytotoxicity increased under the influence of 40-year-old plants. The allelopathic activity of the root environment was maximal at the end of the growing season, which is obviously due to the release of organic compounds from plant residues. The redox status of the root environment of *C. sativa* was characterized by the predominance of reducing conditions, the intensity of which increased under the influence of older plants. At the same time, weakly oxidizing conditions in the control were detected. The values of redox potential of the rhizosphere soil were 1.2–3.5 times lower than control. This indicates the accumulation of mobile organic compounds in the root environment of *C. sativa*. The content of phenolic compounds in the root environment of *C. sativa* was 1.4–2.5 times higher than control. The dynamics of accumulation of phenolic compounds in the rhizosphere soil has shown a tendency to gradually increase their content during the growing season.

Thus, the seasonal dynamics of allelopathic activity, redox conditions, and the content of phenolic allelochemicals in the root environment of *C. sativa* depended on the age of plants. The accumulation of organic compounds of phenolic nature caused obviously an increase in the phytotoxicity of the root environment of *C. sativa* along with the age of the plants.

Keywords: *Castanea sativa*, root environment, allelopathic activity, phenolic allelochemicals, redox potential.

**DEVELOPMENT OF TECHNOLOGY FOR CALLUS BIOMASS OF PLANTS OF
ASTERACEAE BERCHT. & J. PRESL FAMILY AND RANUNCULACEAE JUSS.****Romana Petrina, Sofia Suberlyak, Olha Shved, Viktoriia Havryliak,
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To preserve the natural reserves of plants, especially rare ones, on the verge of extinction or to be included in the Red Book, and to provide quality, environmentally friendly plant materials, a biotechnological method of growing *in vitro* is used. The method has many advantages: biomass is obtained regardless of weather and season, in large quantities, does not contain toxic substances and contains secondary metabolites present in the parent plant. Medicinal plants are an important raw material base for traditional medicines, modern medicines, nutrients, dietary supplements, traditional medicine, pharmaceutical intermediate products, they have many biologically active compounds that can not be obtained by chemical synthesis.

The purpose of this study was to obtain and research biomass of plants family *Asteraceae* Bercht. & J. Presl and *Ranunculaceae* Juss. The study of seeds of *Calendula officinalis* L., *Arnica Montana* L., *Stevia rebaudiana* (Bertonii) Bertonii, *Carlina acaulis* L., *Adonis vernalis* L., *Delphinium elatum* L.

Methods. Seeds of plants were sprout *in vitro* on the Murasige-Skuha (MS) medium at 20 °C aseptically. Plants are transferred to the nutrient medium of MS with the addition of growth regulators for the production of callus biomass. Individual conditions (temperature, illumination, composition, and concentration of growth regulators) were selected for each plant.

The callus biomass was dried, extracts were obtained which were investigated for the presence of secondary metabolites. Extraction of plant material was also carried out. As an extractant, 70 % ethanol is used. Extraction was carried out by infusion over 48 hours when stirring. The extracts were filtered for further studies.

Qualitative and quantitative reactions have been made to determine phenolic compounds, flavonoids, amino acids, vitamins A and C, alkaloids and terpenoids. The content of secondary metabolites in plant callus biomass and plant biomass was comparable.

Results. As a result of the conducted studies, optimal compositions of nutrient media for callusogenesis of plants family *Asteraceae* and *Ranunculaceae* were determined. Also, the influence on the growth of callus biomass such parameters as the size of the explant, the origin of the explant (root, stem, leaf), illumination was investigated. The best results are obtained using explants of at least 0.4–0.5 mm, 2000 lux, 16/8 (light / dark) lighting. The time of cultivation is offered – 40–50 days, depending on the plant. The technology of production of callus biomass of plants is developed *Calendula officinalis*, *Arnica montana*, *Stevia rebaudiana*, *Carlina acaulis*, *Adonis vernalis*, *Delphinium elatum*. The presence of secondary metabolites in plant extracts and callus biomass has been confirmed, and a comparative analysis of the results has been carried out.

Thus, the obtained results testify to the possibility of using callus biomass as an alternative source of secondary metabolites of family *Asteraceae* and *Ranunculaceae*. The developed technology has several advantages, namely profitability, ecological compatibility, plant preservation, process automation.

Keywords: callus biomass of plants, *Calendula officinalis*, *Arnica montana*, *Stevia rebaudiana*, *Carlina acaulis*, *Caltha palustris*, *Adonis vernalis*, *Delphinium elatum*.

GENOMIC FINGERPRINTING OF *LINUM USITATISSIMUM* L. CULTIVARS USING INTRON LENGTH POLYMORPHISM OF γ -TUBULIN

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Linum usitatissimum L. is one of the major oilseed and fiber crops in the world, and its cultivation history spans many thousands of years. Accurate identification of flax genotypes is very useful at all stages of selection, starting with the selection of parental lines and ending with the final use of the obtained raw materials. Currently, various molecular markers are used to identify crop cultivars, including flax. Although some marker systems (such as RAPD, AFLP, ISSR, and SSR) have already been developed for flax, they are sometimes characterized by low reproducibility. A new type of molecular-genetic markers, which is becoming increasingly practical, is the estimation of the intron length polymorphism of genes (Intron Length Polymorphism, ILP). The universality and simplicity of ILP markers allow DNA profiling and genotyping of plants. α -tubulin is critically necessary for the microtubule nucleation, therefore, its amino acid sequence is highly conserved among phylogenetically diverse organisms. Relying on this, we have developed and proposed a new marker system, which is based on the intron length polymorphism of α -tubulin genes. The aim of this work was to verify the possibility of using this marker system for genetic identification of Ukrainian flax cultivars.

A search for conservative exon γ -tubulin sites on the border with introns (in flax and other plant species) and design of degenerated primers (F: 5'-GAYGTBTTYTTTTACCARGCKGA-3; R: 5'-GAGTTGTARGGYTGGACRAC-3) were done. In the case of flax, the amplification covers the region of the 1st and 2nd intron, together with the 2nd exon. Genomic DNA was extracted from fresh leaf tissue and after EPIC-PCR amplification, performed with the one pair of degenerated primers, the products were analyzed on non-denaturing acrylamide gels.

According to the results of the electrophoretic analysis, it was found that bands were formed in a range of 500–600 and 700–900 bp, wherein 4 bands were detected for each cultivar in most cases. It is significant that *Globus* is most different from other cultivars and characterized by 5 bands about 498 bp, 563 bp, 590 bp, 752 bp, 845 bp. However, this flax cultivar is poorly differentiated from other samples using TBP and SSR analysis, as we showed earlier. *Miandr* and *Kameniar* cultivars also differ from other samples in the bands set of DNA profile, as in the case of using TBP and SSR markers.

Thus, this proposed method, based on the intron length polymorphism of γ -tubulin gene, can be easily and successfully used in molecular genetic studies of flax, because it allows to identify, differentiate and evaluate genetic polymorphism of cultivars according to obtained DNA profiles.

Keywords: *Linum usitatissimum*, molecular-genetic markers, γ -tubulin genes, introns.

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INTRON LENGTH POLYMORPHISM OF β -TUBULIN AND ACTIN GENES AS EFFICIENT TOOL FOR *CAMELINA SATIVA* (L.) CRANTZ. GENOTYPING

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Camelina sativa (L.) Crantz. is an ancient oilseed crop, the most promising current source of biofuels. In this regard, a number of different studies of the cultivated species *C. sativa* are being conducted, and its new forms and varieties are being created and introduced. It is often difficult to assess its genetic diversity level, therefore the selection of the most effective molecular-genetic markers for the study of *Camelina* Crantz remains relevant. For this purpose, we carried out molecular-genetic differentiation and genotyping of Ukrainian varieties and forms of *C. sativa* using the intron length polymorphism of β -tubulin and actin genes methods.

This approach is based on simple EPIC-PCR. The universality and simplicity of these methods in the molecular-genetic analysis of plants have already been proved in our earlier researches. Genomic DNA was extracted from fresh leaf tissue and after PCR amplification, performed with the 4 different pairs degenerated primers, the products were analyzed on a non-denaturing acrylamide gel. The results of the 1st intron length polymorphism of the β -tubulin gene analysis showed that the bands were in the range of 295–3200 bp. Wherein, only 7 bands are polymorphic and observed only in a part of the samples, i.e, all of the samples could not be differentiated by this marker. The results of the 1st intron length polymorphism of the actin gene analysis demonstrated that bands are formed in the range of 370–1000 bp, 8 bands are polymorphic. It was possible to differentiate a part of the samples (FEORZhYaF-3, Euro-12, FEORZhYaF-4, FEORZhYaF-D), which did not differ according to the analysis of the previous marker. In order to conduct more accurate profiling of samples, an analysis of the 2nd intron length was involved. Using the 2nd intron length polymorphism of the β -tubulin gene, bands were within 350–1990 bp, 6 bands were polymorphic. And in this case, most of the samples were clearly differentiated from each other, having their own unique DNA profile. All the investigated samples were similar for the 2nd intron length polymorphism of the actin gene. In all cases, the large number of bands was formed, that confirms the fact of polyploidy.

Thus, we found a low level of intervarietal polymorphism of *C. sativa*. This may indicate a high degree of genetic similarity, which is consistent with data obtained using AFLP, RAPD and SSR markers. Also, we determined that the 2nd intron length polymorphism of the β -tubulin gene and the 1st intron length polymorphism of the actin gene are the most effective methods in the case of *C. sativa* profiling, and can be useful in the selection process, for example, in selecting parental pairs or genotyping new varieties.

Keywords: *Camelina sativa*, molecular-genetic markers, β -tubulin and actin genes, introns.

Acknowledgments

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RESEARCH ABOUT THE EFFICIENCY OF USING *SALIX ALBA* L. AND *SALVIA OFFICINALIS* L. IN MEDICINE AND PHARMACY

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Today in the world there are about 12 thousand plants that have healing properties and are used in both traditional and folk medicine. Most often medicinal plants are combined with synthetic substances and other methods of treatment. Herbal medicine is a valuable biogenetic complex that includes active substances: flavonoids, tannins, essential oils, trace elements, vitamins and more. This complex has been formed in a living cell, and therefore has a greater resemblance to the human body than an isolated, chemically pure active substance, therefore it is easier to assimilate and gives fewer side effects.

The object of our study was *Salix alba* L. and *Salvia officinalis* L. In Ukraine, there are about 30 species of willow biology are distributed, of which 27 are wild and 3 are cultivated. The bark of willow is used from ancient times. Willow extract is used to reduce pain and inflammation. The main active ingredient is salicin (0.5 %) – a compound that is similar in its quality to aspirin. Once in the body, salicin is cleaved in the liver to salicylic acid, which leads to a violation of the synthesis of inflammatory mediators by blocking the enzyme cyclooxygenase. As a result, these active substances do not cause inflammatory reactions, including pain. When administered inside the willow promotes improvement in diarrhea and gastritis, dysentery, colitis, arthritis, rheumatism, neuralgia, fever, bronchitis, neurosis. When used externally helps with sweating, sore throat, has a bactericidal effect on the oral cavity during rinsing. Preparations of white willow bark are presented in the form of crushed powder (extract), tablets, capsules, and tea.

Sage is a plant that has a wide medical popularity. The leaves of the sage contain essential oil (0.5–2.5 %), tannins (4 %), triterpene acids (ursolov and oleanol), diterpenes, resinous substances (5–6 %) and bitter, flavonoids, coumarin, esculin and others substances. The plant has an expectorant effect, so sage is part of the herbal collection for the treatment of bronchitis, diuretic properties that allow the treatment of kidney disease. Anti-inflammatory properties of sage help to treat angina, inflammation of the gums and inflammation on the skin. Antimicrobial and antifungal properties are successfully used for the treatment of skin diseases. Sage has a beneficial effect on the work of the brain, it is recommended for prolonged mental workloads and for improving memory. Angiogenesis (the process of formation of blood vessels) plays a key role in the growth and maturation of tumors. It is important for growth, spread of metastases or invasion into organs and tissues. Studies in the field of oncology have shown that a certain therapeutic dose of sage contains ursolic acid, which can suppress the formation of blood vessels in the tumor in the body of the animal and humans. In phytotherapy and folk medicine, the sage is included in the form of internal medicine (infusions, decoctions, tinctures, teas, pills, lozenges, syrups, and mixtures), as well as external (concentrates for lotions, baths, ointments, gels, creams, shampoos).

To sum up, we have developed a gel with white willow bark extract and sage leaves for the treatment of acute and chronic inflammation of the joints. The composition of the gel is methyl salicylate as a base used hydroxyethylcellulose.

Keywords: *Salix alba*, *Salvia officinalis*, salicin, essential oil, inflammation.

**BIOLOGICAL EFFECTS OF LOW-INTENSITY NON-IONIZING RADIATIONS IN MUSHROOMS****Nataliia Poyedinok¹, Nataliia Serhiichuk², Anatoly Negriyko³**

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Mushrooms, one of the most ancient organisms of our planet, have a photo-regulating system of mycochrome. Are well-known such mushrooms responses on low-intensity radiation, such as regulation of speed and growth vector, control of the implementation of the genetic program of individual development. It has now been found that low-intensity light in the blue-violet region of the spectrum in fungi regulates the intensity of hyphae branching, induces carotenogenesis, and accelerates asexual and sexual reproduction processes. The wavelength of light affects a number of metabolic processes.

Our studies the effect of light on spore germination, vegetative growth, biosynthetic activity and fruiting of some macromycetes belonging to different systematic and ecological groups showed that laser radiation in doses of 45–230 mJ/cm² activated the process of spores germination in *Hericium erinaceus* in 10–10⁵ times. Moreover, the effect of radiation was the more effective, than a lower the initial percentage of spore germination was. The study of the effect of light in the range of 430–720 nm, obtained from different sources, on the growth of *Inonotus obliquus* showed that the greatest biological effect, in this case, occurred when the mycelium was irradiated with blue light. At the same time, irradiation with red light, both in the far and near ranges, increased both the rate of linear growth and the accumulation of biomass. On the other hand, the positive reaction of *I. obliquus* to irradiation in the blue and red wavelength ranges supports the theory that two photoreceptor systems exist in melanin-containing fungi: mycochromic and a system involving melanin pigments.

A comparative study of the effect of light of different wavelengths in a continuous, pulsed and intermittent mode on the linear growth of *Ganoderma lucidum* and the accumulation of biomass showed that pulsed and intermittent light has a greater stimulating effect than continuous at the same dose and wavelength.

Low-intensity radiation can act as a stimulator of the biological activity of mycelium not only in mushrooms that need to be illuminated during the formation of fruit bodies but also for *Agaricus bisporus*, which can develop in complete darkness.

Our results suggest that low-intensity light of the visible part of the spectrum can be used as synthesis stimulator of polysaccharides *G. lucidum*, melanins from *I. obliquus*, carotenoids from *Laetiporus sulphureus*. Irradiation significantly affects on the carbohydrate composition of *G. lucidum* exopolysaccharides.

Keywords: mushrooms, low-intensity radiation, biological activity regulation.



PRESERVATION AND PROSPECTS OF USE OF THE OLD FRUIT TREE CULTIVARS

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Preservation of natural-cultural heritage requires protection and introduction into the culture of old cultivars of fruit trees. Today's efforts to gain high crop yields lead to the impoverishment of plant cultivar diversity, particularly of local varieties which have passed the test of time. Detection in old gardens and private farmsteads of ancient varieties which equal or exceed the modern foreign ones in taste qualities and are disease- and pest- resistant may help develop not only a database but also a nursery garden to accumulate and keep genetic resources which are likely to be lost under different circumstances.

The above tasks are important in terms of preserving the diversity and gene pool of cultivated plant forms. As of today, old rural gardens and crofts can be found to hold some cultivars of apple and other fruit trees dating back as far as to XII–XX centuries. Bringing these varieties to light can be achieved through a thorough fruit tree inventory at various localities of a given region, with the subsequent establishment of the base collection. This will make an important step towards conservation of biological diversity of cultivated forms and their introduction into gardening. The planting material (cuttings) is needed to create a bank of old varieties by means of grafting followed by the monitoring of their growth under controlled conditions.

The above measures are necessary to combine with educational and popularization activities among the rural population. It is important to bring to farmworkers the knowledge of old fruit tree varieties and encourage them not to eliminate but maintain these varieties in gardens and farms. Learning about old fruit cultivars, their preservation, and the use of ancient recipes of their processing will appreciably enrich today's cultivar assortment and provide the basis for future selections.

Implementation in 2009–2011 of the mutual Polish-Ukrainian research project 'Inventory of Old Fruit Trees on the Territory of Eastern Galicia' by the Arboretum and Institute of Physiography in Bolestraszyce (Poland) and Botanical Garden of Ivan Franko National University of Lviv (Ukraine) enabled to supplement and broaden the existing collection of historical apple tree cultivars based on material from different regions in Eastern Galicia (currently the territory of Poland and Ukraine) and to collect the authentic planting material of apple varieties preserved in some farms and private gardens. The established collection is unique and serves a bank of genetic material for further selection, and thus it needs additional protection. It is important not only to preserve the old apple-tree variety collection based at the Arboretum in Bolestraszyce but also to enrich it with varieties which are still absent and which, due to qualities such as resistance to pathogens and pests and broad climatic tolerance, will significantly contribute to gardening in the region.

Keywords: old cultivars, fruit trees, collection.

Acknowledgments

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**CRAMBE GRANDIFLORA DC. PLANTS IN VITRO PROPAGATION****Nadia Pushkarova¹, Mykola Kuchuk², Yaroslav Blume¹**

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Crambe grandiflora DC. is an endangered species with high potential for breeding and cultivation as an oilseed, agricultural and technical plant. Due to the limited population's number and protected status biotechnological approaches for plant propagation should be considered. The aim of the presented work was to elaborate efficient *in vitro* propagation protocols and obtaining different types of an aseptic culture of *C. grandiflora*.

C. grandiflora aseptic petiole and leaf explants were used for morphogenic potential and propagation scheme establishment. Explants were cultivated on MS (Murashige and Scoog) medium supplemented with 1 to 5 mg/L of 6-benzylaminopurine (BA) or kinetin and with 0.1 to 1.5 mg/L of 1-naphthaleneacetic acid (NAA) growth regulators in different combinations. For each type of explants, regeneration frequency was estimated. Plantlets were regenerated from petiole explants on every media with BA and NAA that was tested though with different frequency, but cultivation with kinetin and NAA was less successful. With low BA content regeneration frequency was up to 80%. Cultivation on the medium with higher BA concentration (2.5 to 5 mg/L) led to an increase in regeneration frequency up to 100 %. A relation between NAA content (combined with BA) in the medium and regeneration frequency was noted and its optimal level was 0.5 to 1 mg/L.

Leaf explants cultivation on medium with BA and NAA resulted in lower regeneration frequency compared to petiole explants. After BA content increase up to 5 mg/L it was possible to obtain the maximum of 80 % regeneration. On petiole explants callus tissue formed in response to cultivation with BA and NAA from all over the explant and was more than 10 mm wide though on leaf explants callus formed insignificantly and only on the cut ends.

For petiole explants were grown on medium with kinetin and NAA the highest regeneration frequency was observed with relatively low concentrations of kinetin in the medium (1 to 2.5 mg/L). Further increase of kinetin concentration caused lower regeneration frequency. For leaf explants grown on medium with kinetin the same tendency occurred – higher regeneration in response to low kinetin content in the medium. It should be noted that kinetin presence in the medium led to rhizogenesis and practically no callogenesis (only on cut ends) from leaf explants as well as from petioles.

Therefore, the results of presented work are recommendations on the growth regulators content in the medium for fast propagation of *C. grandiflora* plants *in vitro*: for petiole explants – MS with addition of BA 2.5 and NAA 1 mg/L or BA 5 mg/L and NAA 0.5 mg/L and for leaf explants – MS with kinetin 1 and NAA 1.5 mg/L.

Crambe graniflora plants have great potential as a source of biofuel and have a need for protection and propagation measures. Therefore, we established aseptic plants culture and developed recommendations for its fast propagation *in vitro*. Propagation via petiole and leaf explants is possible but for petiole explants, the cultural medium should be supplemented with kinetin and NAA and for petiole explants with BA and NAA.

Keywords: *Crambe grandiflora*, *in vitro* cultivation, oilseed, rare plants, plant propagation.



REACTIONS OF POLLEN OF PLANTS FROM GENUS *LYSIMACHIA* L. ON DIFFERENT ENVIRONMENTAL CONDITIONS

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A cytological study of pollen of different species of the genus *Lysimachia* L. has been carried out. This is part of the comprehensive study of biological, anatomical, cytological, biochemical and molecular genetic features of the common species in Ukraine of this genus. The genetic collection of the genus *Lysimachia* has been begun to create on the territory of Feofania Park in Kyiv which is the government designated park. Representatives of this genus are potentially important species for the purposes of pharmacology and to enrich the biodiversity and efficient use of natural resources. The general appearance and sculpture of pollen grains and the sensitivity of pollen of some species of the genus *Lysimachia* to different conditions of plant cultivation were studied.

The pollen morphology and structure of his shell in of *Lysimachia nummularia* L., *Lysimachia punctata* L. and *Lysimachia vulgaris* L. studied using the scanning electron microscope (JCM-600 Neoscope, IEOL Ltd). The obtained results made it possible to confirm that the shape of pollen grains, the structure of its shell are genetically determined and bear the specific features of the taxon. Only the size of pollen grains *L. nummularia* is slightly smaller (length 30–32 microns, width 12–13 microns) than *L. punctata* (length 32–34 microns, width 17–18 microns).

Growth and development of plants of *Lysimachia* in different conditions of the environment affect the biometric indices of pollen and its fertility. The sensitivity of pollen to exogenous conditions is elevated during the flowering of plants, compared to the phase of budding. There was a tendency towards a decrease in the diameter of pollen grains with the flower opening of the *L. punctata* and *L. vulgaris* in the cultivation of plants in conditions with increased exposure to anthropogenic factors. In *L. nummularia* with the flower opening, the growth of pollen grains continues. Also, a high level of pollen fertility for plants of this species has been established. The fertility of their pollen in the closed ripe bud is more than 90–92 %. In less favorable conditions, plant growth fertility decreases to 73–75 %. Although *L. nummularia* has very low productivity of fruit production and the formation of high-grade seeds in the cultivation of plants in different ecological and climatic conditions.

Similarly, the high natural fertility potential of pollen (80–95 %) in the plant budding phase was noted for *L. punctata*. But there is an active loss of it in the flowering phase when growing plants under anthropogenic loading.

The fertility of the pollen of *L. vulgaris* during cultivation of the plant in favorable conditions also reaches 80–90 %. The pollen of these plants is much larger when grown in the meadow and synanthropic communities than in urban locality. The sensitivity of the pollen of this species to the influence of exogenous factors increases significantly with the onset of flowering of plants. Thus, the high living potential of the pollen of investigated species of the genus *Lysimachia* and their sensitivity to growing conditions are established.

Key words: *Lysimachia* L., pollen, sensitivity.

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EVALUATION OF MORPHOLOGICAL AND MOLECULAR MARKERS OF FLAX (*LINUM* spp.) GERMPLASM COLLECTION

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Newly discovered type of functional markers based on microRNA molecules represents highly efficient, stable, reproducible, low cost and transferable genotyping technique. miRNAs are types of endogenous, conserved, single-stranded, non-coding, 20–25 nt long RNAs with an important regulatory role in plants development and growth. In this research, we focused on the possibility of the interconnection of molecular markers based on miRNA and selected morphological traits.

The variability of the morphological features of flax was evaluated according to the classifier of Nôžková et al. (2011). Genotyping was performed in two replicates. Mechanically undamaged and healthy plants were evaluated in each repetition. The results include image documentation (altogether about 3500 images) at the level of flowers, capsules, in selected phenological phases and after harvesting. Genomic fingerprinting of flax genotypes of different economic type and origin were realized by miRNA markers by the touch-down PCR method.

By using of 6 miRNA markers pairs: gm-miR156b-F/gm-miR-R, lus-miR168-F/lus-miR-R, gm-miR156b-F/gm-miR171a-F, hyp-miR156a-F/hyp-miR414-F, gm-miR171a-F/lus-miR168-F and gm-miR156b-F/lus-miR168-F we confirmed polymorphism and cross-species transferability of conserved miRNA sequences. To distinguish oily genotypes from fiber and wild genotypes the gm-miR156b-F/gm-miR-R marker combination was the most suitable. Unique miRNA loci were amplified by each combination in oily genotype from Ethiopia. Genotypes had the same manifestation in selected morphological traits irrespective of the type and place of origin of the genotype.

Based on the results of the molecular-morphological analysis, unique genotypes originated from Ethiopia and India was identified. Multi-level character classification, of the flower characters, showed that genotypes originating from China, Morocco, and Afghanistan had the same expression and genotypes from India and Ethiopia unique expression in all three observed traits. Genotypes originating in Tunisia and Portugal had a consistent expression in the flower bud color.

By molecular-morphological markers was found, that genotype k-6392 differed in the variability of the number of loci and in the unique expression of traits associated with flowers, from the other tested genotypes.

Keywords: *Linum* spp., miRNAs, molecular markers, morphological markers.

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INFORMATION TECHNOLOGIES IN MODERN BEEKEEPING

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In modern beekeeping, information technologies that are actively working in two directions are being actively implemented: obtaining economic benefits by beekeepers and farmers; increase of ecological safety for bees and products received from them.

The aim of our research was to determine the principles of the operation of information technologies in beekeeping, their applicability and efficiency of use to create conditions for the production of high-quality and safe products.

Analyzing the principles of operation of existing models of modern information technologies in beekeeping, two main types of developments that solve a certain range of tasks are identified: technical (control of the microclimate of the bees' nest and other parameters of the hive); communicative (establishing cooperation between beekeepers, farmers, dealers).

Information technologies that remotely provide the user with data from the apiary on technical parameters (temperature, humidity, hive weight, condition of bee families for analyzing the sound spectrum), allow you to monitor the situation in the apiary and, if necessary, respond to changes. Using smartphone apps, beekeepers can remotely control their bee families. These technologies save time and labor for beekeepers, providing an opportunity for more effective, targeted interventions, as well as increase the income from beekeeping. On the other hand, monitoring the parameters of the development of bees and timely care for them contributes to the preservation of the bee population, and intervention in the bees nest only when necessary favors the biology of the bee family.

Information technologies of the second type are aimed at solving communication issues: the use of bees for pollination of entomophilous crops, the prevention of the loss of bees from pesticide poisoning and pollution of bee products with pesticides, the cooperation of beekeepers. Modern information technologies, using electronic identification of the user, provide the opportunity to conclude contracts online from any computer, tablet, smartphone, conduct transactions, quickly establish communication links with counterparties. An important element in the application of developments of this type is the rapid notification of beekeepers about the treatment of plants with pesticides in the area of their beekeeping activities. These information technologies allow the user to effectively plan their business, improve logistics, reduce commercial risks, and increase the profitability of their business. In addition, information technologies aimed at monitoring and warning about the processing of crops by pesticides, contribute to the solution of global environmental problems - the preservation of the bee population and ensure food safety.

According to the results of the work carried out, it was concluded that a promising direction is the use of IT-development, combining the technical and communicative principles of their use. Such as information technology was applied in Ukraine.

Keywords: IT technologies, beekeeping, communicative, loss of bees.



SYNANTROPIC FLORA IN PHYTOCOENOSES OF THE DNISTROVSKY ECOCORRIDOR

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The ecological network joints biodiversity centers into the integrated spatial system with the ecological corridors as the connecting link of biodiversity conservation spots and species migration (Yatsentyuk, 2012). Moreover, the vegetation in this area is highly fragmented with the pronounced synantropization processes as well as in other regions of Ukraine. The main materials were obtained in field research during the vegetation season of 2013–2017 in Vinnytsia region. For the analysis of phytobiotas, the traditional methods of field research of the synanthropic flora.

Among the selected synanthropic species apophytes were represented by 120 species in the Dniestrovsky ecocorridor. The anthropophytes (adventive species) are represented by 98, species in the respective eco corridor. We have shown that apophytes are mostly represented by 73 species of hemiapophytes (33.4 %) and 47 species of evapophytes (21.5 %). Archeophytes head the group classified by the time of entry in anthropogenically transformed phytocoenoses of the connecting areas (23.4 %). Kenophytes are represented by 44 species (20.2 %) and euchenophytes – the smallest group – only by 3 species (1.4 %). By the mean of the distribution, 65 species of acolytophytes (29.9 %), 28 species of ergasiophytes (12.8 %) as well as 5 species of xenophytes (2.3 %) were registered. The input of individual historical and geographical flora groups is used for the evaluation of parameters characterizing anthropogenic changes in the flora of a certain area. Five indices – synanthropization (IS), apophytization (IAp), anthropophytization (IAN), archeophytization (IAR), and kenophytization (IKn) – were used to determine the degree of anthropogenic transformation of the flora.

The Dniester submeridional ecocorridor has the highest synanthropization index (IS) value of 37.6 %, which indicates the sufficient flora transformation and the significant anthropogenic pressure on phytobiota. This is primarily due to the increased areas of the ploughed fields as well as the possible entry of the synanthropic plant species by railway tracks. Apophytization index reflects the input of aboriginal species in the vegetation of anthropogenically transformed ecotopes. IAp was 20.7 % in Dniestrovsky eco corridor. Anthropophytization index characterizes the role of invasions of adventitious plants in the flora synantropization. IAN was 16.03 %. Archeophytization index represents the input of the species with high naturalization degree entered Ukraine before the 15th century. The background value was 8.8 % in Dniestrovsky. Kenophytization index reflects the intensity of invasions from the 15th to the 20th centuries. Relatively low values – 3.3 % respectively – show the minor role of the kenophytes in the synantropy of the flora of the studied ecocorridors.

The results demonstrate the presence it has been established that the synanthropic flora of the anthropogenically transformed phytocoenoses was formed under the influence of aboriginal flora, and now the apophytization prevail over the adventization.

Keywords: synanthropic vegetation; phytocoenosis; ecological network; ecocorridors; connecting areas.

**ANTIOXIDANT ACTIVITY OF HERBAL TEA FROM LEAVES OF *SOLIDAGO CANADENSIS* L.****Olga Shelepova¹, Yulia Vinogradova¹, Olena Vergun², Ján Brindza³**

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Currently, only a small percentage of plants are widely cultivated. Therefore, the search for new resource species of plants worried about humanity. Invasive species can be one source of valuable nutrient sources. In recent years, the idea has emerged that invasive species can be a reliable resource for using high value-added products, and instead of eliminating them can be a great benefit. So far as many invasive species remain underinvestigated their evaluation is of great interest in terms of discovering new sources of functional ingredients for foods, nutraceuticals, cosmeceuticals, medicines and other applications. In many of the European countries, *Solidago canadensis* L. is considered as commonly distributed invasive species. Numerous interesting organic compounds have been reported for the *Solidago* L. genus, for example, flavonoids, phenolic acids and glucosides, polysaccharides, diterpenes, triterpenoid saponosides, tannins, and essential oils. Flowers have been used in folk medicine as an analgesic, treatment of burns and ulcers, antipyretic, gastrointestinal and hepatic agents. They are also known for their antioxidant properties.

We investigated the leaves of *S. canadensis* and herbal tea from the leaves of this species as a potential source of antioxidants. Herbal teas are popular due to their fragrance and contain lower content of caffeine, which could inhibit calcium absorption. Regular intake of herbal tea is associated with an improved antioxidant status in vivo that may contribute to lowering the risk of coronary heart disease, atherosclerosis, reduced mutagenicity, and inflammation. One of the key steps in the herbs tea manufacturing process is the degree of fermentation the leaves are allowed to undergo.

We compared water and alcohol extracts from fresh and air-dry samples of *S. canadensis* and herbal tea of 2 types of fermentation (fermentation of leaves after deep freezing (F1) and fermentation of fresh leaves (F2)).

Free radical scavenging activity was measured by 2,2-diphenyl-1-picrylhydrazyl (DPPH·) method according to Brand-Williams et al. (1995).

The total antioxidant activity of extracts from fresh leaves of *S. canadensis* was not high and amounted to 34.9 % (aqueous extracts), 35.7 % (ethanol extracts) and 54.7 % (methanol extracts). While the total antioxidant activity of extracts from dry leaves was significantly higher for methanol and ethanol extracts and amounted to 83.2 and 85.8 %, respectively. But it was lower for the water extract – 18.6 %. The total antioxidant activity of the herbal tea samples from the 2 types of fermentation was generally similar and significantly higher than the native samples for aqueous extracts (66.9 (F2) and 58.2 % (F1)). The indices of alcoholic extracts of herbal tea were lower than those for dry leaves, but higher than those of native samples (55.6–56.8 % (ethanol extract) and 74.8–76.6 % (methanol extract)).

Thus, our results demonstrate that *S. canadensis* to be a valid resource in bioeconomy and are a potential source of useful bioactive compounds.

Keywords: *S. canadensis*, antioxidant activity, herbal tea.

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**BIOLOGICAL ACTIVITY OF ETHANOL EXTRACTS OF *GALEGA OFFICINALIS* L.****Oksana Shymanska¹, Olena Vergun¹, Miroslava Kačániová², Ján Brindza³,
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Plants of *Galega officinalis* L. are known as forage, energetic and especially as medicinal plants. It is a source of biologically active compounds that play an important role in regulation and decreasing of sugar content in human blood. *G. officinalis* herb exhibits many biological activities such as an anti-inflammatory, antioxidant, antimicrobial, antifungal, hypoglycemic, diuretic, etc.

In this study investigated the antioxidant and microbiological activities of *G. officinalis* (Fabaceae Lindl.) harvested from the experimental collection of M.M. Gryshko Botanical Garden at both spring growth and flowering periods (above-ground part and root). All analyses conducted in the Slovak University of Agriculture in Nitra. It was determined total content of polyphenols, flavonoids, phenolic acids, antioxidant activity and reducing power of extracts. It was used 9 microbial strains and disc diffusion method for the microbiological study.

We identified that maximal values found for above-ground raw and minimal for roots. Content of polyphenols in the period of spring vegetation and flowering of above-ground part was 53.17 and 62.47 mg GAE/g DW (dry weight), respectively; flavonoids 33.69 and 27.38 mg QE/g DW, respectively; phenolic acids 14.38 and 18.59 mg CAE/g DW, respectively; antioxidant activity by DPPH-method 4.44 and 8.37 mg TE/g DW, respectively and reducing power of investigated extracts was 134.29 and 177.38 mg TE/g DW, respectively. Content of polyphenols in the period of spring vegetation and flowering of roots was 5.27 and 6.87 mg GAE/g DW (dry weight), respectively; flavonoids 0.91 and 1.03 mg QE/g DW, respectively; phenolic acids 2.42 and 3.20 mg CAE/g DW, respectively and reducing power of investigated extracts was 90.13 and 115.20 mg TE/g DW, respectively. Antioxidant activity by DPPH-method in the roots not detected.

Antimicrobial activity of roots extracts was higher than in above-ground extracts. Inhibition zone was from 1.00 (against *Candida tropicalis*) to 5.00 (*Salmonella enterica*) mm for roots extracts at the spring growth and from 1.50 (against *C. tropicalis*) to 3.67 (against *Staphylococcus aureus*) mm in roots at the flowering period. Inhibition zone 1 mm was detected against *Salmonella enterica*, *Klebsiella pneumoniae*, and *Candida glabrata* only at the period of spring growth. Against other microbial strains, extracts were ineffective. In a period of flowering inhibition zone detected from 1.17 (*C. glabrata*) to 1.50 (*S. aureus*, *Candida albicans*, *Salmonella enterica*) mm.

Thus, this study demonstrated that plants of *G. officinalis* are a rich source of antioxidant compounds. Antimicrobial activity was better in roots extracts. The results can be used in farther pharmacological investigations with different concentrations.

Keywords: *Galega officinalis*, antioxidant properties, polyphenols, antimicrobial activity.

Acknowledgements

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TRANSGENESIS AS A TOOL FOR WIDENING OF THE GENETIC VARIATIONS AND USING OF MEDICINAL PLANTS

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Medicinal plants are the richest bioresources of drugs for traditional and modern medicine. Their compounds are included in herbal health care formulations, herbal nutrients, and herbal-based cosmetics. To obtain plants with new characteristics and properties the transgenic technology can be used. *Agrobacterium rhizogenes* is a soil bacterium and a natural tool for transgenesis: it causes hairy root formation at the site of infection. Hairy roots can produce higher levels of useful secondary metabolites, change their composition, or reveal novel bioactive compounds valuable for herbal medicine. Plants regenerated from hairy root culture often have an altered phenotype.

The aim of our work is obtaining transgenic medicinal plants via hairy root cultures and estimation of their characteristics and properties.

For obtaining transgenic plants we chose five medicinal herbs often used in Ukrainian folk medicine and pharmaceutical industry, namely *Silybum marianum* (L.) Gaertn., *Matricaria chamomilla* L., *Origanum vulgare* L., *Lavandula angustifolia* Mill., and *Lophanthus anisatus* (Nutt.) Benth. Seeds were surface-sterilized for obtaining *in vitro* aseptic plant cultures. Two sterilizing methods were tested: rinsing in 75 % ethanol following 4 % hypochloride solution or rinsing in 70 % ethanol with 0.1 % Triton-X100, and next washing in distilled water. Then seeds were placed on nutrient Murashige-Skoog (MS) agar medium. Seedling was germinated and grew in the growth chamber at 24 °C. Adult plants were cloned, and the regeneration media were selected. Species showed well-developed regeneration protocol were transformed by *A. rhizogenes* to obtain hairy root culture.

Testing of seed sterilization methods demonstrated that using of hypochloride solution is more effective against fungal contamination but affect essentially on germination efficiency. The most effective protocol was developed for *L. anisatus* where seed germination was about 100 % with no contamination. *L. angustifolia* and *M. chamomilla* had less viable seeds after sterilization but germinated seedlings grew well and produced stable *in vitro* culture. Used sterilization protocols were not effective for *S. marianum* and *O. vulgare* species, and although a few *in vitro* adult plants were obtained for these species, they finally died because of severe fungi attack. Species were also checked for cloning and regeneration efficiency. *L. anisatus*, *L. angustifolia*, *O. vulgare*, and *S. marianum* showed effective growth and root formation on MS medium after shoot/stem cutting. *M. chamomilla* has leaves arranged in rosettes and sometimes two rosettes appear so it was possible to divide them for cloning; root formation and plant growth were good on MS medium. Regeneration potential was checked for *L. anisatus*, *L. angustifolia*, and *M. chamomilla*. New plants were nicely regenerated on MS medium supplemented with phytohormones 1 mg/L BAP and 0.1 mg/L IAA from *L. anisatus* and *L. angustifolia* explants. Preliminary results showed that nutrient media contained kinetin will be more suitable for *M. chamomilla* regeneration. *A. rhizogenes*-mediated transformation of *L. anisatus* and *L. angustifolia* is in the progress.

The results demonstrate that some species are very convenient for *in vitro* manipulations and can be used for obtaining medicinal transgenic plants with altered properties.

Keywords: medicinal plants, *Agrobacterium rhizogenes*, hairy roots, transgenic plants.



IMPLEMENTATION OF THE PROCESS OF AUDIT OF SUPPLIERS ON RETAIL OF UKRAINE

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The trading network, before allowing its manufacturer shelves, performs the function of the controlling body and independently checks its compliance with the regulatory act of food law. Not all suppliers agree on such conditions, but most understand that such approach to the choice of suppliers is in favor of all parties: the customer (trade networks) to the supplier (manufacturer), consumers and government bodies. The customer receives a trusted partner who, having invested a certain resource in bringing production into conformity, will have the possibility of long-term cooperation. A supplier who has received the status of a supplier of a particular trading network receives much more: a trusted customer; conformity of production with more stringent requirements than legislative ones, which in turn creates conditions for constant assurance and readiness for any measures of state supervision and audit; attractiveness for other customers. Work on this model drives the economy of the country forward by implementing the production facilities modern efficient technologies.

Representatives of International Companies in the Ukrainian market have achieved much better results. By concluding long-term contracts for decades of uninterrupted supplies of the standard product, they require the supplier to meet their internal requirements. Vendor evaluation and selection procedures are based on internal standards, which in almost all sections outstrips the legislative requirements of not only Ukraine but also other countries.

We conducted an audit of suppliers for the WOG network and set the level of compliance of suppliers with the requirements of the food chain. According to our methodology, the supplier has an appropriate assessment of the compliance level (from 1 to 100 points) for each section of the audit. Suppliers with an overall score of few than 70 points are not eligible for further cooperation.

We can conclude that among the tested enterprises, there are those who are of excellent quality and good, but most do not have an inappropriate level of 5 enterprises out of 12. 7 enterprises have an inadequate level in the audit section – the implementation and compliance of the safety management system. This reflects the state of compliance of the food market with the requirements of the Law "On Basic Principles and Requirements for the Safety and Quality of Food Products". 9 enterprises have an inappropriate level at least in one section of the basic program of preconditions.

As a matter of fact, now many trading networks underestimate the effectiveness of the process of proper supplier audit. The best supplier is not always the one who offers the lowest price or high quality.

The supplier's audit will help reduce dependence on uncontrolled risks, reducing direct and indirect overheads of enterprises and organizations. Ultimately, the implementation of this business process will allow you to seriously improve the quality and safety of the company's products, as well as reduce the cost of incoming control.

Keywords: food safety, HACCP, audit, producer, supplier, tender.



ANALYSIS OF THE KEY ASPECTS OF GLOBAL G.A.P. AND PERSPECTIVES OF ITS IMPLEMENTATION IN UKRAINE

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New consumer demands, retail demands, and legislation have led to development the new requirements for farmers and producers of agricultural products, such as: reducing the impact of rural production on the environment, minimizing the use of chemicals and the rational use of natural resources, while worrying about workers, farm animals and marine fauna. The necessity for commitment and good agricultural practice has become the primary objective of certification of farms under the GLOBALG.A.P standard also known as "Integrated Farm Assurance Standard" (IFA) – Integrated Farm Assistance System.

Today GLOBALG.A.P. is an internationally recognized standard of agricultural production, which is the result of many years of intensive research and collaboration with industry experts, manufacturers and retailers around the world. It is the only integrated standard for primary products that allows the use of separate modules for different product groups - from plant production, animal production, to the production of mixed fodder and which defines the minimum safety requirements required by the consumer. In order to develop the GLOBALG.A.P standard, in addition to good agricultural practices, the concept of Hazard Analysis and Critical Control Point (HACCP) has been applied, which has proven among food manufacturers and processors of agricultural raw materials. On this basis, the main sections of the new standard, covering the whole process of growing, processing, storing and even transporting products to the buyer, were developed.

A characteristic feature of the standard is the tracking of the entire production chain. One of the main requirements for the manufacturer is the scrupulous attitude to fixing all the actions in the production process. GLOBALG.A.P standard provides for a number of risk assessments to be made to promote food safety, employee hygiene and health, environmental protection and the social module. The social model is referred to as GRASP which stands for good risk assessed social practice. Some retailers require this add-on module before they will accept the certification. Other customers will require a stronger and more specialist social practice audit. The grasp model is actually a risk assessment and not a social audit. The grasp module looks at the basic aspects of legal employment and health and safety on the farm and provides a minimum standard that reflects international law. It does not address many of the social complications such as migrant labor, sexual harassment, and trade unions. However temporary workers, lack of employment contracts and the use of young workers such as students can cause complications and the grasp module is often a good way that the farm can measure itself against the international requirements in a common sense way.

First of all, for Ukrainian manufacturers in the primary sector, certification is GLOBALG.A.P. is a prerequisite for the export of fresh fruits, vegetables, and other products, guaranteeing the safety of products for consumers of retail chains. Consumers seek to obtain assurances that any food they receive from the fields does not pose a risk to their health and production is carried out using environmentally sound methods.

Keywords: standard, GLOBALG.A.P, safety, farmer, requirements, risk assessment, agriculture.



SCREENING OF WHEAT CULTIVARS WITH EFFECTIVE RESISTANCE GENES TO THE HIGH VIRULENT STRAIN OF STEM RUST UG99

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Stem rust is a dangerous disease of such important cereals as wheat and barley, caused by *Puccinia graminis f. sp. tritici*. Among a large number of strains of this fungus, Ug99 is known as most devastating. Ug99 strain demonstrates high dynamics of distribution during the last decades and the ability to mutate. Main wheat stem rust resistance genes are not efficient against this strain. There are some foreign wheat varieties which provide resistance to Ug99, but their direct use is not possible in Ukraine because of agrotechnical characteristics. Therefore, it is very important to create the own Ukrainian wheat varieties with resistance to Ug99.

The main purpose of this work was to select the molecular-genetic markers for the detection resistance genes to Ug99 strain of stem rust and the selection of foreign wheat lines/varieties with effective resistance genes to strain Ug99 for further transfer and pyramiding to modern Ukrainian wheat cultivars. As a result, the list of molecular-genetic markers for effective resistance genes to the Ug99 strain (namely Sr2, Sr33, Sr39, Sr40 genes) has been generated. This list included the nucleotide primer sequences, the annealing temperature, the length of the expected amplicon, etc. Also, some of them can be used in the study of the allelic state of resistance genes, for example csSr2, Sr39 # 22r, Sr39 # 50s, Wmc344, Gwm374.

The presence of resistance genes to Ug99 in domestic and foreign breeding wheat cultivars was determined using PCR. Genomic DNA from wheat seedlings was obtained using the CTAB method. After PCR amplification the products were analyzed on a non-denaturing acrylamide gel. A list of wheat cultivars of national and foreign breeding with resistance genes to the Ug99 that can be used for crossings was created. It consisted of 16 samples: (RL5711 x W984-8767), (RL6087 x W984-8767), DH31, (RL5711 x FL62R1), RL6087, RL5711, (RL6087 x Hoffman), Selkirk, DK20, (RL5711 x Carberry), (RL6087 x Carberry), Pembina, HK16 – the country of origin is Canada; Renown – the country of origin is United Kingdom; Kharkivska 6, Kharkivska 12 – the country of origin is Ukraine. In total among 16 tested specimens, it was found 13 which are characterized by the presence of resistant alleles of one or another Sr gene (*Sr 2, Sr 33, Sr 39, Sr 40*). Among the varieties of Ukrainian breeding (Kharkivska 6 and Kharkivska 12), involved in the study, none resistance alleles of the studied Sr genes was showed.

Keywords: wheat, stem rust, strain Ug99, resistance genes, PCR analysis.

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VARIABILITY OF MICROSATELLITE SEQUENCES DISTRIBUTION IN CULTURAL AND WILD GENOTYPES OF AMARANTH (*AMARANTHUS* L.) GENOMES

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The aim of the study was to assess variability and distribution of microsatellite sequences in 15 cultural genotypes of *Amaranthus caudatus* L., *Amaranthus cruentus* L. and *Amaranthus hypochondriacus* L. and 14 wild genotypes of *Amaranthus hybridus* L., *Amaranthus palmeri* S. Watson, *Amaranthus retroflexus* L., *Amaranthus spinosus* L. and *Amaranthus tuberculatus* (Moq.) Sauer. Polymorphism between cultural and wild species of amaranth (*Amaranthus* L.) was analyzed using ISSR markers.

The biological material (seeds) was obtained from the North Central Regional PI Station (NC7), Iowa State University, Ames, USA. The DNA extraction was performed by Rogers and Bendich optimized method. Primers (CA)₆AG, (CA)₆GG, (GT)₆CC, (GTG)₃GC, (GAG)₃GC and (GA)₆CC were used for ISSR analysis. PCR was performed with 20 ng of DNA, 20 mmol.dm⁻³ Tris-HCl, pH 8, 50mmol dm⁻³ KCl, 1 U Taq polymerase, 3 mmol.dm⁻³ MgCl₂, 0.1 mmol. dm⁻³ deoxyribonucleotides, 0.2 μmol. dm⁻³ primer. The following program was used for amplification: 94 °C for 2 min, 45 cycles of 94 °C for 1 min, 50 °C for 1 min, 72 °C for 2 min and a final extension 72 °C for 7 min. Fragments were separated on 2 % agarose gel. Based on amplified DNA fragments, a matrix of genetic distances of the presence and position of the DNA fragments was assembled. The interdependencies were constructed by the UPGMA hierarchical cluster analysis based on genetically related coefficients in STATISTIKA program.

The most synthesized fragments were provided by primer (GAG)₃GC. The least synthesized fragments were provided when using (CA)₆GG primer in PCR. Nei Li coefficient values ranged from 0.36 to 0.65. The lowest Nei Li value was provided using (CA)₆AG primer in PCR.

Markers ISSR have great potential for generating a large number of informative characters for phylogenetic analysis. Two primers (CA)₆AG and (CA)₆GG used in PCR revealed clustering of four *Amaranthus hypochondriacus* genotypes originated in Nepal and India in a separate cluster. Primer (GA)₆CC revealed similar results, four *Amaranthus hypochondriacus* genotypes in one cluster together with wild *Amaranthus retroflexus* genotype originated in India. Primer (GAG)₃GC revealed independent cluster with *Amaranthus palmeri* genotype originated in Mexico.

On the basis of repetitive sequences (GT)₆CC and (CA)₆AG distribution, genetic similarity between *Amaranthus caudatus* L. genotypes and *Amaranthus tuberculatus* (Moq.) Sauer was assessed. ISSR with (GTG)₃GC primer revealed the genetic similarity between *Amaranthus caudatus* L. and *Amaranthus spinosus* L. genotypes in a separate cluster.

Keywords: amaranth, *Amaranthus caudatus*, *Amaranthus cruentus*, *Amaranthus hypochondriacus*, *Amaranthus hybridus*, *Amaranthus palmeri*, *Amaranthus retroflexus*, *Amaranthus spinosus*, *Amaranthus tuberculatus*, ISSR, diversity.

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***SCHISANDRA CHINENSIS* (TURCZ.) BAILL. IN THE COLLECTION OF THE M.M. GRYSHKO NATIONAL BOTANICAL GARDEN OF UKRAINE**

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The M.M. Gryshko National Botanical Garden of the NAS (NBG) of Ukraine is a well-known center for the introduction, acclimatization, and selection of unusual and rare fruit crops, among which introduced species from the Far East are of particular significance. One such species is the *Schisandra chinensis* (Turcz.) Baill. (magnolia-vine), a member of the genus *Schisandra* Michx. in the family *Schisandraceae* Blume.

The genus *Schisandra* includes 25 species distributed in tropical and subtropical regions of Asia: in north-eastern, central, and south-eastern China (Manchuria), in Korea, in the Far East of the Russian Federation, in the east of Thailand, in Cambodia, Vietnam, Nepal and some regions of India, Burma and Japan, and in North America.

The purpose of the research into the history of the introduction of *S. chinensis* at the M.M. Gryshko National Botanical Garden of the Ukrainian, the creation of the collection, and characteristics of the introduced population.

Establishment of a botanical-geographical 'Far East' section was planned at the NBG as early as 1938–1939, according to the general plan of O.I. Sokolovsky and G.O. Stepunin. Seeds of *Schisandra chinensis* were first obtained in 1949 at the Khabarovsk Research Institute of Forestry. The second successful attempt was made in 1951 in the Suputinsky natural reserve of Primorsky Region. Later, in 1966, the scientist O.O. Pirozhenko brought from an expedition to the Primorsky Region the seeds of nearly 100 species of Far East Flora (including the magnolia-vine). The seedlings were planted in the botanical geographical section. According to Y.K. Gotsyk, nearly 16 % of seedlings began to bear fruit in the third year after planting. In ten years, magnolia-vine plants became thickly woven in the trees, reaching a height of 3 m. Today, there is a stable introduced population with all vegetation ages in the 'Far East' botanical-geographical section, where *Schisandra chinensis* reproduces both by seeds and vegetatively. This introduced population was a source of promising forms for local reproduction, which later became the initial selection material. Selection of magnolia-vine as a fruit crop was begun at the NBG by I.M. Shaytan in the 1950s. The seeds were obtained from Ivanovo (Russia) and by local reproduction. As a result, a collection of *S. chinensis* was formed, now containing more than 200 plants. The collection is represented by highly productive forms characterized by resistance to pests and diseases, winter hardiness and large fruits. The promising form Sadovy 1 was selected from the grown seedlings (in 1959); after testing it acquired the status of a cultivar and was entered in the Ukrainian register of plant cultivars. The plant shoots grow intensely, and fruiting is abundant (3–5 kg of fruits per shrub) and yearly.

Magnolia-vine has great economic value and is used as a valuable food, ornamental and medicinal plant.

Keywords: *Schisandra chinensis*, history of introduction, selection, cultivar.

QUALITATIVE EVALUATION OF THE MAYONNAISE AND DETERMINE THE BEST MANUFACTURER

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The indisputable factor of success of a trademark is the quality of the product manufactured. Mayonnaise is the white sauce made from oil, the yellow part of eggs, and vinegar / or lemon juice, sugar. The quality of mayonnaise is determined by the complex of indicators such as organoleptic (taste, smell, colour, consistency), physicochemical (fattiness, starch, acidity, the presence of acids), microbiological (bifid bacteria, microorganisms, yeast, fungi, bacteria).

When preparing multicomponent food products, for example, mayonnaise, to ensure the necessary consumer properties, not only the uniform distribution of components in the product volume but also its qualitative homogenization is important.

The research was carried out on the example of samples of Ukrainian manufacturers of various trademarks. The mayonnaise samples were analyzed according to organoleptic, physical and chemical, microbiological indicators. The packaging and labelling of the product were assessed as well.

To detect the level of the quality of mayonnaise the 5-point descriptor-profile method of sensory analysis was used and a group of experts was involved.

The results of the labelling analysis have proved no indication of index E in food additives descriptions of the following trademarks: 'Korolivsky Smak' Korolivsky and 'Olis' Provansal.

The descriptors of organoleptic indicators (consistency, taste, smell and colour), packaging labelling and design have been suggested, their 5-grade scale of profiling determined. The descriptor-profile method helps to distinguish the most competitive and attractive for the consumer product. 'Korolivsky Smak' Korolivsky and 'Torchyn' Provanskiy have got the highest evaluation mark.

Physicochemical studies of mayonnaise show that all the samples contain 0.18 % to 0.51 % of acidity, 67.0 % of fat which is indicated in the packaging information. The amount of sorbic acid is within the norms – not more than 1000 mg/kg. Apart from this, 'Olis' uses benzoic acid as a preservative which is not indicated in the description and its content is 19.4 mg/kg.

Pathogenic microorganisms will not grow in mayonnaise or sauce made in industrial conditions, as their pH is 4.4, and the titratable acidity of the aqueous phase is at least 0.43 for acetic acid. However, some researchers have found that *E. coli* 0157: H7 can be stored for several weeks. Homemade mayonnaise can cause food poisoning outbreaks. Micro-biological research has detected no violation by any manufacturer.

The results of research mayonnaise on physicochemical and microbiological indicators of proving that their values fully compliant comply with the requirements of current regulations.

Keywords: mayonnaise, labelling, quality, organoleptic, descriptor.



CONTENT OF POLYPHENOL COMPOUNDS IN ETHANOL EXTRACTS OF *NEPETA GRANDIFLORA* M. BIEB.

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Plants of *Nepeta* L. widely known as a source of biologically active compounds and use in folk medicine due to pharmacological and biological activities. These plants distributed in Central and South Asia, Europe, Middle East, etc. These herbs have been used in folk medicine to treat different disorders. Raw of *Nepeta* herbs exhibit such biological activities as an anti-inflammatory, analgesic, antinociceptive, anti-atherosclerotic, antimicrobial, antifungal, antiviral and repellent.

In this study investigated the antioxidant activity of *Nepeta grandiflora* M.Bieb. harvested from the experimental collection of Experimental Facility “Novokakhovska” of Rice Research Institute of Ukrainian Academy of Agrarian Sciences, v. Plodove at the both flowering and fruitage periods. All biochemical analyses conducted in the Slovak University of Agriculture in Nitra. It was determined total content of polyphenols (expressed in gallic acid equivalent (GAE)), flavonoids (expressed in quercetin equivalent (QE)), phenolic acids (expressed in caffeic acid equivalent (CAE)), antioxidant activity (expressed in Trolox equivalent (TE)) and reducing power (expressed in Trolox equivalent (TE)) of extracts. All measurements carried out on the spectrophotometer Jenway (6405 UV/Vis, England).

We identified that content of polyphenols among investigated plant extracts was from 21.84 (fruits; fruitage period) to 63.73 (leaves; flowering period) mg GAE/g of DW (dry weight). The content of flavonoids was from 10.08 (fruits; fruitage period) to 34.07 (leaves; flowering period) mg QE/g of DW. Content of phenolic acids of alcohol extracts was from 5.48 (fruits; fruitage period) to 27.97 (inflorescences; flowering period) mg CAE/g of DW. Antioxidant activity by DPPH-method was from 8.54 (leaves; fruitage period) to 9.05 (fruits; fruitage period) mg TE/g of DW. Reducing power of investigated extracts was from 18.60 (fruits; fruitage period) to 134.29 (inflorescences; flowering period) mg TE/g of DW. It was found a very strong correlation between reducing power of extracts and content of polyphenols, phenolic acids, flavonoids as 0.98, 0.96 and 0.84 respectively.

Thus, this study demonstrated that plants of *N. grandiflora* are a rich source of antioxidant compounds possessing the antioxidant activity such as polyphenols, flavonoids, and phenolic acids, which are correlated with reducing power of extracts by phosphomolybdenum method. Along with other species of this genus, *N. grandiflora* can be used in the pharmacological study.

Keywords: *Nepeta grandiflora*, polyphenols, phenolic acids, flavonoids, antioxidant activity.

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EFFECT OF WATER STRESS ON PHYSIOLOGICAL AND GENETIC PARAMETERS AT ANTHESIS STAGE IN WINTER WHEAT GENOTYPES DIFFERING BY MATURITY

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The effectiveness of the research is that the study of the dynamics of changes in physiological and genetic parameters of wheat genotypes, differing from the drought effects of the soil according to the soil climate of the country, and its role in productivity. The aim of the research is to teach the dynamics of morphophysiology and genetic variation of the durum and bread wheat genotypes, which are introduced from international breeding centers and adapted to local conditions, and also to give specific recommendations on the selection of wheat genotypes in different soil and climatic conditions.

The objects under studying in the 2017–2018 academic year, 12 different wheat genotypes were measured in the Absheron Experimental Base of the Institute in three groups (early, medium and late maturing). As a result, two genotypes from each group were compared, including durum and bread wheat. During the research, genotypes were determined by the speed of photosynthesis (Fi), transpiration speed (Ti), carbon dioxide (CO₂) in intercellular areas, and the American-made LI-6400 in upper layer leaves. The main results were as followed: developmental stages influenced wheat photosynthesis greatly and tiller stage played more roles; there is significant difference in the main photosynthetic parameters, photosynthesis rates (Photo), stomata conductance (Cond) and transpiration rates (Trans), general photosynthesis and drought resistance in different wheat genotypes was related much to their domesticated origin soil-water environment and selected generations and there was a photosynthetic threshold effect in terms of different wheat genotypes at soil water deficits.

From the early maturing wheat genotypes Garakilchik-2 durum wheat genotype, both in the two versions, separately on the 8th and 7th layer leaves, Fi-14,2, 16.9/8.3-13.5 (mmol CO₂ m⁻²s⁻¹), CO₂g 342; 365/355; 376 (mmol CO₂ moll / 2) and finally Ti-value 3.9; 6.7/2.8; 4.2 (mol H₂O m⁻²s⁻¹), bread wheat genotypes of Nurlu-99 type Fi-13,5; 11.6/10.2; 12.4 (mmol CO₂ m⁻²s⁻¹), CO₂q-328; 345/356; 388 mmol of CO₂ moll / 2 and finally Ti-4.2; 7.1/3.9; 5.4 (mol H₂O m⁻²s⁻¹). At the flowering phase Fi-19,6; 17.4/21.9; 18.7 (mmol CO₂ m⁻²s⁻¹), Ti-9,2; 7.4/6.3; 8.2 (mol H₂O m⁻²s⁻¹), compared to the previous measurements, the difference between the variants was significantly lower compared to those observed in the third measure.

From here, it can be concluded that there is a difference between durum and bread wheat genotypes, compared to the other varieties within the group. This is due to the fact that early maturing genotypes complete their development before the severe drought occurs, which leads to a small difference in variants. This in turn ultimately leads to yield loss. In the future, it is important to pay attention to the fact that such genotypes should be taken as parental forms for the creation of new varieties.

According to the obtained results, for the all assimilating organs of the early maturing genotypes, the earing phase is considered to be the most favorable. Thus, the most active metabolism occurs during the mentioned growth phase of the plant.

Keywords: water stress, wheat genotypes, physiological and genetic parameters, drought resistance.



PROPERTIES OF MICROBIAL α -L-RHAMNOSIDASES IMPROVING THE AROMA OF WINES AND TASTE OF JUICES

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α -L-Rhamnosidase [K.F. 3.2.1.40] is an enzyme that cleaves terminal non-restored L-rhamnose residues present in both synthetic and natural glycosides, oligo-, polysaccharides, various glycoconjugates, flavonoids derivatives – routine, neohesperidin, hesperidin, naringin, quercitrin, saponins, ginsenosides; terpene glycosides – aziaticosides. Derhamnosilation of natural glycosides can increase their biological activity and have a positive effect on the quality of food products. Hydrolyzing terpene the glycoside enzyme promotes the release of aromatic compounds that enhance the aroma of grape juices and wines, and the hydrolysis of naringin, hesperidin, and routine improves the quality of citrus juices.

Earlier in the Institute of Microbiology and Virology of the National Academy of Sciences of Ukraine, as a result of the screening of microorganisms – representatives of various taxonomic groups from the Ukrainian collection of microorganisms, the producers of α -L-rhamnosidases were selected: *Eupenicillium erubescens*, *Cryptococcus albidus* and *Penicillium tardum*. From the investigated enzymes, *C. albidus* α -L-rhamnosidase was characterized by a greater affinity for natural substrates than for synthetic ones.

Therefore, the purpose of the work was to study the possibility of practical use of *C. albidus* α -L-rhamnosidase. The enzyme preparation was isolated from the supernatant of the culture filtrate of the producer by precipitation with ammonium sulfate (up to 90 % saturation) followed by chromatography on charged and neutral TSK gels (DEAE-Toyopearl 650-s and Toyopearl HW-60 Toya Soda Japan, respectively). To determine the activity and specificity of the action of the enzyme, p-nitrophenyl derivatives of monosaccharides were used. The ability to hydrolyze natural substrates was evaluated using methods of Davis and high-performance liquid chromatography.

It was shown that the enzyme exhibits a narrow specificity with respect to glycon of synthetic substrates, the hydrolyzes only p- nitrophenyl- α -L-rhamnopyranoside (K_m 4.5 mM) and p-nitrophenyl- β -D-glucopyranoside (K_m 10 mM). The most effective *C. albidus* α -L-rhamnosidase degraded naringin ("Sigma") (K_m 0.77 mM), releasing prunin and naringenin. K_m for neohesperidin ("Sigma") was 3.3 mM. The effectiveness of the grapefruit and pomelo juice hydrolysis was 94 and 98 % for 60 min (40 °C, 2 units/ml). As a result of the treatment of green tea, mandarin and orange juice, a decrease in the content of routine, nary routine, and hesperidin were observed, indicating the ability of α -L-rhamnosidase to cleave α -1,2- and α -1,6-bound rhamnose from natural flavonoids. Thus, it was shown the effectiveness of the use of *C. albidus* α -L-rhamnosidase for hydrolysis both commercial preparations of flavonoids and citrus juices and green tea. The obtained results in perspective can be used in food technologies for the production of juices, the improvement of the aroma of wines.

Keywords: α -L-rhamnosidase, *Cryptococcus albidus*, specificity, naringin, neohesperidin, routine, flavonoids.

INDUSTRIAL RECEIVING OF BEE BREAD IN BEEKEEPING COMMUNITIES

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The technology of receiving bee bread using demountable made up honeycomb was developed not long ago. It is successfully used in the apiaries with not numerous bee colonies. At the same time, this technology hasn't been widely spread in bee farms and beekeeping communities. The aim of this work is to develop a technological scheme of producing beebread for industrial apiaries. It will encourage increasing of production of beebread and improving its quality.

The object of research was the bee colonies of the apiaries in the central region of Ukraine. While developing the scheme of receiving beebread, feed supplies of the areas with apiary spots (50–60 colonies on one spot) were taken into consideration. Research group – bee colonies of the apiaries, which had in the zone of productive flight of bees a big number of melliferous and polliniferous plants were used for obtaining bee bread (group1). At the apiaries with a poorer bee forage bee colonies were used for processing pollen into bee bread (group 2). It was here where the bee bread collected during a day was brought. The bee bread was poured and tightened up into the honey combs prepared earlier and then they were placed to the bikes for 2 weeks. To compare the effectiveness of this developed scheme several commercial apiaries were used (control) where technological chain consisted of getting from the colonies both pollen and bee bread. On each variant of bee bread production, the labour productivity and the amount of commercial production in conversion to a bee colony were defined.

Working on a general scheme of getting bee bread it was established that correlation between the colonies from which pollen is received and those used for bee bread production depends on the period of the season. So, for the period of flowering of winter rape, orchards, forest wild grasses it is enough to have 4–5 bee gardens for getting bee pollen and one bee garden for its processing into bee bread. When the process collecting of pollen is falling down – first half of summer, the correlation must be 7–8 bee gardens to 1. By getting pollen and bee bread separately, labour productivity increases 3.4–4.2 times as much. Related to one bee colony for this option, it was received 48.1 % more of the commercial production than in the control group.

Taking into consideration the high effectiveness of industrial obtaining of bee bread using demountable made up honeycombs, it is reasonable to have a separate scheme of technologies at bee farms and beekeeping communities. Correlation of bee colonies for obtaining pollen and bee bread must be defined with regard to the period of the season and food supply of the area.

Keywords: bee bread, the technology of obtaining, beekeeping communities.

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**BIOCHEMICAL COMPOSITION OF FOUR SPECIES OF *CRAMBE* L.**

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Species of plants of *Crambe* L. belong to *Brassicaceae* Burnett and their number achieve up to 40. Last time investigations of these plants focused on their biochemical composition especially oil content and energetic value. Plants of *Crambe* have economic interest also because of low damage for soil quality, characterized by drought-resistance. Investigation of accumulation of different compounds in above-ground part of these plants, also, an important aspect for evaluation of perspective of use. The aim of this study was to compare the peculiarities of the biochemical composition of *Crambe* species dynamically. In addition, our previous investigation identified the high antioxidant activity of different extracts of investigation plants.

Plant material collected from the experimental collection of M.M. Gryshko National Botanical Garden of the NAS of Ukraine. It was studied above-ground parts of *C. cordifolia* Steven, *C. koktebelica* (Junge) N.Busch, *C. maritima* L., *C. steveniana* Rupr. At the spring vegetation, budding stage, flowering, and fruitage. Following biochemical parameters was studied: dry matter by drying to consist weight at the 105 °C (Ermakov, 1972); content of sugars by Bertrand's method using of glucose scale, ascorbic acids with 2,6-dichlorophenolindophenol, tannins with indigo carmine discoloration, organic acids by sodium hydroxide titration with phenolphthalein (Krishchenko, 1983), carotene with gasoline galosh spectrophotometrically (Pleshkov, 1985), ash in muffle over (Hrycaenko et al., 2003).

We identified that during vegetation the dry matter was from 9.76 (*C. cordifolia*, budding) to 22.54 (*C. maritime* at the fruitage) %, total content of sugars from 6.54 (*C. maritime* at the fruitage) to 33.18 (*C. cordifolia* at the budding) %, ascorbic acid from 139.85 (*C. maritime* at the spring vegetation) to 987.02 (*C. maritime* at the budding) mg%, carotene from 0.39 (*C. maritime* at the budding) to 1.82 (*C. cordifolia* at the fruitage) mg%, tannins from 1.28 (*C. cordifolia* at the fruitage) to 7.47 (*C. steveniana* at the budding) %, content of organic acids from 3.12 (*C. steveniana* at the fruitage) to 6.28 (*C. koktebelica* at the spring vegetation) %, ash from 6.11 (*C. maritime* at the spring vegetation) to 14.61 (*C. cordifolia* at the flowering) %. Correlation analysis showed that between the content of tannins and organic acids existed positive moderate correlation ($r = 0.51$). Between other parameters found the weak, very weak positive or negative correlation.

It's should be noted that the accumulation of nutrients in the above-ground part of investigated plants was uneven. This depends on species and stage of grow.

Thus, comparing biochemical analyze identified that raw of four species of *Crambe* is a valuable source of nutrients during vegetation. The high content of sugars, ascorbic acid, and carotene can recommend these plants as forage crops. Also, raw of these plants can be recommended for farther pharmacological investigations.

Keywords: *Crambe*, biochemical composition, raw.

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**CONTENT OF PHOTOSYNTHETIC PIGMENTS IN THE LEAVES OF *CRAMBE* L. SPECIES**

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Pigment complex is an important parameter in the ecological study and it is a marker of plant condition related to the environment. In this case, the most used parameters are the content of chlorophylls, carotenoids, and their ratio. The previous study of *Crambe abissinica* Hochst showed that exists a correlation between the content of nitrogen and chlorophylls in the leaves.

In this study, we used to investigate the content of chlorophyll *a* (Chl *a*), *b* (Chl *b*), carotenoids (*car*) and their ratio in four species of *Crambe* L. during vegetation: *C. cordifolia* Steven, *C. koktebelica* (Junge) N.Busch, *C. maritima* L., *C. steveniana* Rupr. collected in the M.M. Gryshko National Botanical Garden of the NAS of Ukraine (Kyjiv). Middle height increment of investigated plants between stages of growth given. The concentration of chlorophylls *a*, *b* and *car* measured spectrophotometrically on UNICO 2800 at the wavelength 662, 644 and 440, respectively. Extraction procedure conducted in acetone (Musienko et al., 2001). Obtained results are given in mg/g of fresh mass.

The height increment in a period of spring vegetation-budding was 26.3–80.2 cm, budding-flowering 12.3–136.0 cm, flowering-fruitage 1.3–16.6 cm depending on species. *C. cordifolia* had the most value of this parameter at the budding–flowering period and *C. maritima* had the least value at the flowering–fruitage period.

Content of chlorophyll *a* at the spring vegetation period was 0.321–0.490 mg/g, at the budding period 0.237–0.680 mg/g, at the flowering period 0.349–0.680 mg/g and at the fruitage 0.478–0.962 mg/g depending on species. Content of chlorophyll *b* was 0.133–0.203 mg/g at the spring vegetation stage, 0.158–0.275 mg/g at the budding stage, 0.158–0.275 mg/g at the flowering stage and 0.227–0.439 mg/g at the fruitage depending on species. The concentration of carotenoids was 0.038–0.078 mg/g at the spring vegetation period, 0.043–0.104 mg/g at the budding period, 0.070–0.201 mg/g at the flowering period and 0.117–0.435 mg/g at the fruitage depending on species.

In the start of vegetation between process of grow and accumulation of photosynthetic pigments exists the correlation. So, a correlation between the content of Chl *a* and increment of plants was strong at the spring vegetation ($r = 0.78$), moderate at the budding period ($r = 0.52$) and strong at the flowering ($r = 0.76$). At the flowering stage found a very strong correlation ($r = 0.90$) between Chl *b* content and increment. Very strong and strong correlation found between increment and *car* content at the spring vegetation ($r = 0.84$) and budding period ($r = 0.69$), respectively. Also, a very strong correlation identified between the increment of plants and the ratio of chlorophylls ($r = 0.89$) at the end of vegetation.

Thus, obtained data showed that between the accumulation of photosynthetic pigments of investigated plants and increment of plants exists positive correlation, which depends on the period of growing. Further, it's can be used for the study of total productivity and some grow parameters of these plants.

Keywords: *Crambe*, chlorophyll *a*, chlorophyll *b*, carotenoids.

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**POSSIBILITY OF USING ALIEN *ADENOCAULON ADHAERESCENS* MAXIM. (ASTERACEAE) AS THE MEDICINE PLANT****Yulia Vinogradova¹, Anastassia Ganina¹, Olena Vergun²**¹N.V. Tsitsin Main Botanical Garden of Russian Academy of Sciences, Moscow, Russian Federation;
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The searching for new resource plant species is the main target of humanity. In this respect, the genus *Adenocaulon* attracts our attention. *A. adhaerescens* Maxim. is the perennial herb, distributed in Russian Far East. This species has not yet been used anywhere. On the other hand, the aerial part of closely related *A. himalaicum* Edgew. has been used in China, Korea, and Japan for treatment abscess, hemorrhage, and inflammation (Hak, Kang, 2001). Previous chemical investigations of *A. himalaicum* indicated that caffeic acid derivatives were the main components (Kulesh et al., 1986). Acetylene and a monoterpene glycoside have been isolated (Hak, Kang, 2001) and a new tricyclic- α , β -unsaturated ketone (adenocaulone) and a new δ -hexane lactone glycoside (adenocaulolide) have been isolated later (Wang et al., 2007). Wang et al. (2007) employed the cup-plate method and they reported, that adenocaulolide exhibited antibacterial activity against *Escherichia coli* and *Staphylococcus aureus*. Many compounds active against cancer cells have also been reported. Extract originating from the aerial part (but not from the roots) of *A. himalaicum* is active against human gastric adenocarcinoma (MK-1), human uterine cancer (HeLa), mouse melanoma (B16F10) and human T-cell lymphotropic viruses of type 2 (MT-2) (Kinjo et al., 2016).

However, according to Korean scientists, the antioxidant activity of *A. himalaicum* was low: 20.2 % (methanol extracts) and 17.8 % (aqueous extracts) (Lee et al., 2011). Despite this data, we examined aqueous and alcoholic extracts derived from different organs of *A. adhaerescens* as potential antioxidants. Plants were collected in the Main Botanical Garden of Russian Academy of Sciences. We collected separately leaves and inflorescences from 10–20 plants per each local population.

Free radical scavenging activity was measured by 2,2-diphenyl-1-picrylhydrazyl (DPPH \cdot) method according to Brand-Williams et al. (1995).

The total antioxidant activity of extracts from young plants collected in April 2018 was quite high and had 79.73 % (methanol extracts), 80.37 % (ethanol extracts) and 34.40 % (aqueous extracts). In September 2018, the total antioxidant activity of extracts from leaves was lower and had 76.48 % (methanol extracts), 59.26 % (ethanol extracts) and 47.99 % (aqueous extracts). The total antioxidant activity of extracts from inflorescences was higher: 83.42 % (methanol extracts), 84.90 % (ethanol extracts) and 48.84 % (aqueous extracts). Thus, our results demonstrate a broad reaction norm of phytochemical characteristics within the vegetation season.

Our results indicate that alien *A. adhaerescens* may be useful as potential antioxidant sources for improving human antioxidant defense system. We recommend seedlings or inflorescences of this taxon for further study.

Keywords: *Adenocaulon*, antioxidant activity, invasive species.

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ANTIOXIDANT ACTIVITY OF ALIEN *GALINSOGA* SPECIES

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So far only about 5 % of plants are widely cultivated as useful ones. That's why the searching for new resource plant species has worried the humanity. However, nowadays the possibility of using the whole group of invasive species, whose secondary distribution range is expanding year by year, has not been adequately studied. Alien invasive species may be used as valuable sources of nutrients and they are particularly recognized for their antioxidant properties. In this respect, the genus *Galinsoga* Ruiz & Pavón (Compositae: Heliantheae) attracts attention. According to the modern revision, genus *Galinsoga* consists of two American species: *G. parviflora* Cav. and *G. quadriradiata* Ruiz & Pavón (= *G. ciliata* (Raf.) S. F. Blake. Both species became already invasive in Russia and are included in 'Top 100' of the most aggressive invasive species. *Galinsoga* species are used in folk medicine as anti-inflammatory agents and accelerators for wound healing. They also have reported antioxidant activity.

We examined aqueous and alcoholic extracts derived from the *Galinsoga* as potential antioxidants and compared 2 species, 2 habitats and 2 different organs of the plant. Four specimens were included in the analysis: *G. parviflora* from Nesvizh, Belarus (GpN) and from Moscow district, Russia (GpM); *G. quadriradiata* from Nesvizh, Belarus (GqN) and from Moscow district, Russia (GqM). We collected separately leaves and inflorescences (heads) from 10–20 plants per each population.

Free radical scavenging activity was measured by 2,2-diphenyl-1-picrylhydrazyl (DPPH·) method according to Brand-Williams et al. (1995).

The total antioxidant activity of extracts from leaves for all specimens was quite high and had 53.63–80.45 % (methanol extracts), 78.07–93.23 % (ethanol extracts) and 59.87–88.36 % (aqueous extracts). The total antioxidant activity of extracts from heads is higher for methanol extracts and had 77.89–85.54 %, but lower in the other cases: 36.19–86.85 % (ethanol extracts) and 24.38–49.06 % (aqueous extracts). The lowest antioxidant activity in alcohol extracts from heads was shown by Gq, and the highest one by Gp. Conversely, aqueous extracts from heads have the lowest antioxidant activity in GqM and the highest one in GqN. The total antioxidant activity of alcoholic extracts from dry leaves was highest for GpM; aqueous extracts from leaves for all 4 specimens were equal.

Thus, our results demonstrate a broad reaction norm of phytochemical characteristics within the invasive populations of both *G. parviflora* and *G. quadriradiata*. Our observations suggest that invasive *Galinsoga* taxa have a potential source of useful bioactive compounds.

Keywords: *Galinsoga*, antioxidant activity, invasive species.

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'FLORAL-DIP' GENETIC TRANSFORMATION OF *AMARANTHUS CAUDATUS* L. WITH HETEROLOGOUS GENES

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Nowadays, amaranth becomes popular due to its rich biochemical composition and unique medicinal properties. In connection with this, it is promising to improve its properties with the help of biotechnological methods.

The aim of this work was to evaluate the presence of the transferred *bar* gene and *nos terminator* in amaranth tissues, and to obtain transgenic plants of amaranth after the 'floral-dip' genetic transformation.

The objects of the investigation were local cultivars of species *Amaranthus caudatus* L.: Helios, Karmin. The above-mentioned cultivars were transformed by method 'floral-dip'. After 'floral-dip' transformation with *Agrobacterium tumefaciens* strain GV3101 with vector pCB125 and *A. rhizogenes* strain A4, with vector transgenic seeds were obtained. All mentioned vectors contained *bar* as a selectable screenable marker.

The incorporation of the T-DNA into amaranth cells was confirmed with herbicide selection (herbicide Basta®, Bayer CropScience AG, Germany). For this purpose, the lowest lethal dose of Basta herbicide on amaranth seedlings was detected in our previous experiments (160 mg/l of herbicide).

Seeds obtained from plants not subjected to agroinfiltration were grown in plastic pots with soil in greenhouse conditions (22–26°C, 14-hour light period, illumination 3000–4500 lx). At the age of two weeks, the seedlings were sprayed with concentration 160 mg/l of herbicide. The amaranth plants were used as negative control grown without herbicide spraying. Spraying of seedlings was conducted in order to fulfil the selection of assumedly transformed plants with the presence of *bar* gene.

After spraying with the herbicide, tolerant plants were obtained for cultivars: Helios and Karmin.

Percentage of tolerant plants *A. caudatus* cv. Helios (with vector pCB125) to the effect of the herbicide (160 mg/l) was 4.05 %, cv. Karmin (with vector pCB125) to the effect of the herbicide (160 mg/l) was 2.4 %. Percentage of tolerant plants *A. caudatus* cv. Karmin (with vector pCB131) was 1.2 %.

After conducting of PCR analysis, positive results were obtained for the presence of *bar* and *nos terminator*. The percentage of *bar*-positive plants was 0.6 % ('Helios', vector pCB125); 0.1 % ('Karmin', vector pCB131) from total initial quantity of seeds. The percentage of *nos terminator*-positive plants was 0.15 % ('Helios', vector pCB125) from total initial quantity seeds.

After conducting a series of experiments, transgenic plants of amaranth were obtained after the 'floral-dip' genetic transformation. The transgenic plants were obtained for cultivars Helios and Karmin, species *Amaranthus caudatus*. The presence and functioning of the transferred *bar* gene and *nos terminator* in amaranth tissues were confirmed by PCR analysis.

Keywords: transformation, *Agrobacterium*, *Amaranthus*.

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PHOTOSYNTHETIC PIGMENTS OF *VACCINIUM CORYMBOSUM* L. (CV. ELLIOTT) SHOOTS: CONTENT AND PERSPECTIVE OF USAGE

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Vaccinium corymbosum L. (highbush blueberry) has become widespread during the last decade. Highbush blueberry is a long-blooming deciduous shrub belonging to the section Cyanococcus, genus *Vaccinium*, heather family (Ericaceae). Species of highbush blueberries introduced and grown in Ukraine especially in their ecological optimum because are vulnerable to changes in environmental factors (Shlapak et al., 2013). It is possible to indicate their physiological state according to the pigment complex, which is interesting and relevant for *V. corymbosum*, so as herbal pigments are not only responsible for the absorption, transmission, and transformation of light energy into photosynthesis but are also biologically active. Chlorophylls and carotenoids are sources for therapeutic applications, including antioxidant, antitumor, anti-inflammatory action, photothermal, photodynamic therapy.

The aim of the work was to investigate the peculiarities of the accumulation of photosynthetic pigments (chlorophylls a and b, and carotenoids) in the *V. corymbosum* L. shoots of Elliott variety and their changes in different periods of vegetation in order to evaluate the possibility of using as herbal medicinal material.

Shoots of *V. corymbosum* Elliot cultivar, grown in Lviv region of Ukraine, were collected in the season of 2017–2018. The collection of plant material – shoots of *V. corymbosum* variety Elliott, was carried out during the period of spring vegetation (I), the period of flowering (II), the period of fruiting (III), the period of previous winter rest (IV). For comparison, *V. uliginosum* shoots were used, as an aboriginal European species of Ericaceae. Plant material was air-dried in the dark and ground to the powder. Pigments of airborne shoots of highbush blueberry were extracted with acetone (80 and 100 %), ethanol (96 %), and diethyl ether. The content of pigments was determined spectrophotometrically. The optical density of the extract was determined at wavelengths that correspond to the absorption maxima of chlorophylls a and b and carotenoids for each solvent. The concentration (in mg•L⁻¹) of chlorophyll a (Chl a), chlorophyll b (Chl b), chlorophyll a+b (Chl a + b), and carotenoids were calculated according to the formulae described in Musienko et al., 2001.

It was established that the best solvent for extraction of chlorophylls in *V. corymbosum* shoots is 100 % acetone, as compared to 80 % acetone, 96 % ethanol, and diethyl ether. The highest content of both chlorophylls was in the flowering and fruiting stages. The content of chlorophylls in the shoots of *V. corymbosum* is higher compared to the *V. uliginosum*. The total content of carotenoids in the *V. corymbosum* and *V. uliginosum* shoots was not significantly different at the fruiting stage.

Keywords: *Vaccinium corymbosum* L. cv. Elliott, shoot, chlorophyll, carotenoids.



INFLUENCE OF THE FERMENTATION CONDITIONS ON THE PHENOLIC COMPOUNDS CONTENT, ANTHOCYANINS, AND THE SPECTRAL CHARACTERISTICS OF CABERNET SAUVIGNON WINES

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The wine characteristics have been determined by the variety potential and specificity, but also by the yeast strain carrying out the alcoholic fermentation. Phenolic components and anthocyanins play a significant role in the formation of organoleptic wine qualities, especially of red wines. The yeasts influence the wine color primarily with the extracellular β -glucosidase produced by them.

The objective of the study was to investigate the influence of the technological factors yeast strain, temperature and inoculum amount of yeast culture on the variation of the total phenolic substances and anthocyanins during the alcohol fermentation and on the spectral characteristics of Cabernet Sauvignon wines.

The experiment was carried out with grapes of Cabernet Sauvignon variety with sugars content of 23.10 % and titratable acids of 6.15 g/dm³. The alcoholic fermentation was conducted with inoculum amount of yeast culture 2 %, 3 %, 4 % of the *Bordeaux* and *8-11* strains of *Saccharomyces cerevisiae* species and fermentation temperature 20 °C, 24 °C, 28 °C. The course of the process was followed by the variation in the dry matter, measured daily with the Abbe refractometer. The dynamics of the total phenolic compounds content and anthocyanins during the fermentation was determined by measuring on 1st, 5th, 10th and 20th day. After the alcoholic and the malolactic fermentations in the experimental wines were also analyzed the content of flavonoid phenolic compounds, non-flavonoid phenolic compounds, and their spectral characteristics.

The results demonstrated that under the experimental conditions both strains *Bordeaux* and *8-11* exhibited the best fermentation activity at 28 °C. The temperature factor had a stronger impact on the variations of total phenolic compounds and anthocyanins in the course of the alcoholic fermentation. The quantitative maximum of both indicators was recorded on the 5th day of the process. In the experimental wines, the variants fermented under the conditions of 28 °C/4 % contained more total phenolic compounds, anthocyanins, flavonoid phenolic compounds, non-flavonoid phenolic compounds, and the red color ratio was the highest. The wines of *8-11* strain were distinguished by a higher total phenolic compounds content, anthocyanins and, respectively, more intense color.

Keywords: wine, yeast, alcoholic fermentation, phenolic compounds, spectral characteristics.



PHENOLOGICAL GROWTH STAGES OF THE *DIOSPYROS VIRGINIANA* L.

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Species of the genus *Diospyros* spp. belong to the family Ebenaceae Gürke. In Europe, the considerable interest of national economy to constitute such kinds of as: *Diospyros kaki* L. (Japanese persimmon) and *Diospyros virginiana* L. (American persimmon), fruit plants as food, *Diospyros lotus* L. (Date plum) – as rootstock, *Diospyros virginiana* – as a rootstock and as a source of high winter hardiness at the hybridization. The natural range of *Diospyros virginiana* includes the eastern part of North America from Connecticut to Iowa and from Kansas to Florida. Today more than 200 cultivars of *Diospyros virginiana* exist and their fruits have differences in fruits shape, size, color, and ripening. The *Diospyros virginiana* is of great practical interest for fruit growing. In addition, the American persimmon is a valuable decorative and medicinal plant. For the last years was derived good cultivars of *Diospyros virginiana* and some of them are superior the best cultivars of *Diospyros kaki*.

Climate change and other adverse global factors in each region have a significant effect on the cultivation of plant species. It is, therefore, necessary to gradually introduce and test the adaptation of less-known and less-used plant species for different practical uses in each region. In Ukraine conditions, the *Diospyros virginiana* is being tested for a longer period of time. In order to recognize the adaptation of each species, it is necessary to know, inter alia the phenology of the species.

The aim of the study was the determination of the main phenological growth stages of *Diospyros virginiana* in the conditions of M.M. Gryshko National Botanical Garden of NAS of Ukraine (Kyiv). For the study of the issue, we used 12 individuals produced in the Botanical Garden. Experimental data gained in years 2018–2019 in phenological studies of *Diospyros virginiana* were utilized to describe phenological growth stages of given species. For the description of phenological growth stages, it was used by BBCH Monograph (1997). Phenological observations and time data collection were provided at regular intervals in the text form and photo documentation. Complex phenological growth stages were processed based on the phenological records. Resulting data will be used for the list of descriptors preparation specified for the given species and oriented on the practical utilization in the research, breeding, and genetic resources investigation. A feature of the system is that homologous stages of different crops are presented by the same codes.

This study made it possible to accurately identify and describe the phenological stages of perspiration growth of *Diospyros virginiana* from the growth bud development (stage 0) and ending with the senescence. Beginning of dormancy (stage 9). The stage of bud development (stage 0) and the stage of inflorescence emergence (stage 5) are described most fully. This makes it possible to use the advantages of the extended BBCH scale to describe the fruit crops for further research.

Keywords: *Diospyros virginiana*, BBCH-code, growth stage.

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**MORPHOMETRIC PARAMETERS OF GENOTYPES OF *LYCIUM CHINENSE* MILL. IN
COLLECTION OF M.M. GRYSHKO NATIONAL BOTANICAL GARDEN
OF NAS OF UKRAINE**

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Goji berries are a new promising food and medicine crop. Under the name of the goji, use the fruits of two species of genus *Lycium* L.: *L. barbarum* L. and *L. chinense* Mill. Goji berries have a high antioxidant effect, anti-hyperglycemic, anti-cancer, and anti-aging properties, due to the presence in the fruits high amount of ascorbic acid, specific polysaccharides and betaine. Under the crope of goji in China, more than 150,000 ha are occupied, they are grown in Europe and the USA. Berries are consumed in fresh and dried form, juices, wine, preserves and as the substitute of tea made of leaves. There is a limited amount of data on the biology of this species in the literature. In Ukraine, it has not been investigated or grown in the industrial size. In 2015, we began to create a collection and explore the goji in M.M. Gryshko National Botanical Garden of NAS of Ukraine (Kyiv).

The purpose of the study was to determine the variability of some morphological characteristics of fruits *L. chinense*. The obtained results will help to select promising genotypes for further breeding work and to evaluate the prospects of promising using selected samples.

The objects that have been studied are fruits *L. chinense* of a collection of plants growing in M.M. Gryshko National Botanical Garden of NAS of Ukraine from seeds or cuttings obtained from China, France, Slovak Republik and other botanical gardens of Ukraine. Eight genotypes were investigated in an experimental study in 2018, including 3 cultivars (Big Lifeberry, Delikate, Q1) and 4 varieties. Morphometric characteristics are derived from 50 fruits per genotype. The study used one plant per genotype. The following measurements were made: the weight of the fruit (g), the length (mm), the diameter (mm), the number of seeds per fruit.

The fruits differed in weight, shape, size, color, and number of seeds. Rugged fruits in different genotypes acquire orange, red to dark red color. Morphometric indices were as follows: fruit weight from 0.62 to 0.99 g, fruit length from 8 to 15 mm, fruit diameter from 8.03 to 13.54 mm, seed number in fruit from 16 to 28, fruit form index varied from 0.76 to 2.34. Analysis of the variation coefficient showed differences in the morphological characteristics between *L. chinense* samples. The data showed that the most varied is the number of seeds in the fruit from 8.78 to 38.63 % and the weight of the fruits is 16.32 to 22.92%.

The results show a narrow reaction norm within the introduction population. The two selected genotypes LC03 and LC04 are characterized by a greater weight of fruits than the studied varieties. Varieties LC01, LC02, LC04 are characterized by a lower coefficient of variability of the weight of the fruit than in cultivars and are more stable. Three specimens have the largest fruit (weight) and can be used for further breeding as food cultivars. One specimen with the most amount of seeds can be used as an oil source.

Keywords: goji, *Lycium chinense*, fruits, new crop.

ANALYSIS OF PEANUT GERMLASM VARIABILITY BY LENGTH POLYMORPHISM AMONG THE PBS SITES OF RETROTRANSPOSONS

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Arachis hypogaea L. is a popular oil-seed crop that is a part of many national cuisines. The diversity of uses of peanuts is an evidence of its antiquity – the seeds are eaten at one of several stages from immature to fully ripe, raw, or cooked. They are processed by boiling, broiling, roasting, crushing or grinding and mixing with other food. The aim of the study was to analyse specific fingerprints of inter primer binding sites polymorphism of retrotransposons in the genome of peanuts.

In total, twenty-one accessions were used in the study, collected in the *in situ* in Bolivia as seeds and planted in pots. First, different iPBS markers were tested to be effective in analysis and subsequently, three different markers were chosen. Amplification was performed by following PCR program setup: initial denaturation 95 °C for 3 min, followed by 35 cycles of 95 °C for 30 s, 55 °C for 40 s, 72 °C for 2 min and a final extension at 72 °C for 5 min. Generated fingerprints profiles were evaluated for the presence or absence of individual amplified loci. A Jaccard coefficient of genetic similarity was used together with UPGMA analysis in PCoA.

Polymorphism level has ranged from 48 % up to the 75 % of used primer. Polymorphic information content has ranged from 0.33 up to the 0.46 for the individual primers and cophenetic coefficient has ranged from 0.83 up to the 0.91. None of the used iPBS markers was considered to distinguish all of the analyzed accessions when evaluate obtained fingerprints alone, but combining them in the final analysis, the level of genomic polymorphism was sufficient to separate the analyzed *Arachis hypogaea* germplasm.

This study considers iPBS markers as sufficiently polymorphic in the genome of peanut that will be useful in the assessment of its diversity and germplasm management for use in breeding and conservation.

Keywords: peanut germplasm, DNA markers, variability, polymorphism.

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ANALYSIS OF SELECTED DROUGHT-TOLERANCE GENES IN ALADIN AND SELADON WHEAT CULTIVARS

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Genes of drought resistance of common wheat (*Triticum aestivum* L.) DREB1 and DREB2 are located on the chromosome group 3 (A, B, D) of hexaploid wheat and they are present usually in one copy. DREB3 is contiguous homologue to gene TmCBF5 and it was determined on the chromosomes of groups 5, 6 and 7. The aim of the study was to characterize available nucleotide records for mRNA and linear DNA of genes of drought resistance of common wheat with using the bioinformatic algorithms and to compare their nucleotide record by sequencing of the selected section for species Aladin and Seladon.

Sequences of DREB2 gene are available in NCBI database in 26 records in total. By using blastn algorithm was determined their similarity at the nucleotide conformity level. Direct PCR amplicons sequencing was performed to obtain the partial sequence of DREB2 from two analysed wheat varieties. Region of nucleotides 1707 – 2634 of *T. aestivum_DREB2 gene_1BL_scaff_031713_54707-60515* (unpublished) was amplified and sequenced. PCR products were purified by 1,5 IU FastAP™ alkaline phosphatase and 10 U of exonuclease I. Purified amplicons were sequenced in direction 3'-5' by reverse amplification primer by GenomeLab™ DTCS. Nucleotide alignment algorithm was used to compare obtained sequences among themselves and with those in public databases and a consensus sequence was generated.

The highest volume of similarity of nucleotide sequences of DREB2 genes was found with the cover in rank 2–100 % and nucleotide conformity at volume 66–100 % for the sequences stored in the public databases. Results of sequencing were the strength of 824 nucleotides for both of the analysed varieties. Any nucleotide differences between analysed varieties were not determined by sequencing of the chosen section of DREB2 gene in Aladin and Seladon even though they are differently physiologically based related to drought resistance. When comparing the obtained sequences to the *T. aestivum_DREB2 gene_1BL_scaff_031713_54707-60515* that was used for primer design, many nucleotide insertions, substitutions and deletions were found.

Keywords: wheat; DREB2 gene, Aladin, Seladon.

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ABSTRACT ONLY



***CARYA ILLINOINENSIS* WANGH. IN FOREST-STEPPE OF UKRAINE: INTRODUCTION AND PROSPECTS OF USE**

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Carya illinoensis Wanhg. (*sin. Carya pecan* (Marshall) Engl. et Graebn.) – fast-growing deciduous tree, belongs to the family of nut (Juglandaceae). Natural area – North America, where it grows in deciduous forests of temperate climate, is widespread in the culture of the United States and successfully grown on other continents as fruit and ornamental plant.

C. illinoensis at home reaches 60 m height. The trunk of the tree – straight, can reach a diameter of 2 m, with a highly raised rounded crown. Leaves – complex pinnate, with broad-lanceolate, dark green, shiny, serrated at the edges of the leaves. The leaves are large, length up to 30–50 cm. Color of leaves at the spring period light green, at summer period bright green, at autumn period orange-yellow with a whole range of shades.

The aim of the research was to sum up the results of the introduction of *C. illinoensis* in the Forest-Steppe of Ukraine, to determine the prospects of this species.

In the M.M. Gryshko National Botanical Garden (Kyiv, Ukraine) the exposition of the nut trees was formed since 1950. Observations of *C. illinoensis* have been conducted since the 1960s, when it was introduced there. The collection grows three pecan trees with a flat trunk and a high-pitched spreading crown. Their height is 20, 18 and 21 meters; trunk diameter at the level of 1.3 m from the ground surface is 60, 75 and 74 cm, respectively.

The opening of vegetative buds of the pecan comes 15.04 ± 1.5 , floral – 25.04 ± 1.0 . Flowering lasts until the third decade of May. The beginning of the growth of sprouts coincides with the date of flowering leaves (15.04 ± 1.5). Fruiting of trees is annual. Ripening occurs in the third decade of September (23.09 ± 2.8) and lasts until the third decade of October (28.10 ± 1.4). In some years, the timing of fruiting, the quality of the fruit in the same instances are very different. Thus, in 2017, the fruiting of the studied pecan specimens occurred in the middle of the first decade of October (5.10 ± 3.5) and lasted until the first decade of December (3.12 ± 2.8). In 2017, 30 % of the performed fruits were noted, and in 2018 – 85 %. Fruit weight in 2017–2018 varied from 2.0 to 6.1 g, respectively; coefficient of variation was 71.6 %. The thickness of the shell in these years was 0.8 to 1.3 mm; the coefficient of variation was 33.3 %. The autumn color of leaves is observed at the end of the first decade of September (27.09 ± 7.4). The beginning of leaf fall was noted at the end of the first decade of October (08.10 ± 2.8), which lasts one month.

Thus, the duration of the phenological phases of pecan differs by year and lasts from 198 to 208 days (average 203 ± 7.1), which coincides with the vegetation period of the Forest-Steppe of Ukraine. The heterogeneity of the quality indicators of *C. illinoensis* fruits in different years may indicate its insufficient acclimatization in the region of introduction.

Attracting more shaped and varietal composition of pecans in the Forest-Steppe of Ukraine will enable the selection of stable specimens to the conditions of introduction and widespread use of this economically valuable species of the genus *Carya* in Ukraine.

Keywords: *Carya illinoensis*, introduction, Forest-Steppe of Ukraine.



INFLUENCE OF PHOTOPERIODIC INDUCTION ON THE CONTENT OF PROTEIN IN SOYBEAN (*GLYCINE MAX* (L.) MERR.) GRAIN

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Soybean is one of the most valuable foods, feed and industrial crops in the world and in Ukraine. Its value is determined by the high content of protein in the grain, oil, complex of biologically active compounds and trace elements.

Soybean cultural in its biological properties refers to the heat-loving short-day plants, which hinders its cultivation in regions with an insufficient amount of effective temperatures and a photoperiod of more than 16–17 hours in the daily cycle. In such regions, the majority of high-yielding soybean varieties retard development, late bloom and ripen, which leads to a decrease in productivity and grain quality. In this regard, it is necessary to study the dependence of the formation of grain quality on environmental factors and, in particular, on the duration of the photoperiod.

The aim of our work was to determine the effect of the photoperiod on the protein content in soybean (*Glycine max* (L.) Merr.) cultivars with different photoperiodic sensitivity. The soybean cultivars of Ukrainian selection – Annushka, Yatran, Ustya, and Khadzhibey were used as model plants. In preliminary experience by us, it is shown that in the conditions of a natural long day (16 hours) and short day (9 hours) three first varieties began to blossom and ripened simultaneously, and Khadzhiebj's grade on a short day began to blossom and ripened for 10–15 days before on a long day. Consequently, the Annushka, Yatran and Ustya cultivars are photo periodically neutral, and the Khadzhibey variety is a short day. The experiments were carried out in field conditions at the experimental site of the Department of Plant Physiology and Biochemistry at V.N. Karazin Kharkiv National University. Sowing was carried out the optimal time for the eastern Forest-Steppe of Ukraine – in the second or third decade of May. Until the third true leaf, the plants grew under a natural long day (16 hours at the latitude of Kharkiv – 50 degrees east latitude). In this phase, half of the plants of each cultivar were exposed to a short day (9 hours). For this, the plants were dimmed with opaque cabins from 5 p.m. to 9 a.m. This effect continued for 14 days. Then all the plants were grown on a natural long day until the end of the growing season. After ripening, the Kjeldahl total nitrogen content was determined in the soybean grain. The protein content was calculated using a ratio of 6.25.

The obtained data showed that under the influence of photoperiodic induction by a short photoperiod in the soybean cultivars Annushka and Yatran the protein content decreased by an average of 1 % compared to the content on a long day. In the Ustya and Khadzhibey grains, the protein content under the influence of a short day increased on average by 0.9–1.0 %. It is likely that the accumulation of protein in soybean grain depends on the genotype of the cultivar and photoperiodic vegetation conditions.

Keywords: Soybean (*Glycine max* (L.) Merr.), protein, photoperiod.



IN VITRO CONSERVATION, MASS PROPAGATION AND SOME BIOCHEMICAL CHARACTERISTICS OF *FITTONIA ALBIVENIS* (LINDL. EX VEITCH) BRUMMITT, AN ACANTHACEAE SPECIES

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Acanthaceae family consists of 4300 species in 346 genera and is, therefore, one of the most diverse families of flowering plants. Besides the fact that Acanthaceae plants possess an important ecological role in their native habitats they contain many important secondary metabolites and are used for the treatment of many diseases.

Fittonia albivenis (Lindl. ex Veitch) Brummitt (synonyms *F. argyroneura* Coem., *F. verschaffeltii* (Lem.) Van Houtte) is a species of Acanthaceae family native to the Peruvian rainforests and known as “nerve plant” or “mosaic plant”. Several publications point at *Fittonia* ethnopharmacological properties, which make *F. albivenis* an interesting object for further studies. However, its growing *ex situ* apart from the natural habitat in rainforests requires special conditions and makes it necessary to elaborate efficient methods of cultivation and biomass accumulation for the research and practical application. *In vitro* culture can be a promising approach in this respect.

In this work we describe a procedure of *F. albivenis in vitro* conservation and microclonal propagation by enhanced bud proliferation from shoot tips as well as studying some biochemical characteristics of plants cultured both *in vivo* and *in vitro*. Multiple shoot formation from apical and axillary buds started in 4 months on MS/2 medium without growth regulators. Multiplication coefficients ranged from 6.0 ± 1.9 to 14.7 ± 2.6 for different plant clones. Regular transfer of shoot clusters to the fresh MS/2 medium resulted in increasing multiplication efficiency. The total quantity of regenerated plants of the most rapidly growing clone #2 per 8-months cultivation reached more than 1500 plants. In our research, a hormone-free medium was used for growing *F. albivenis* plants to ensure their clonal stability *in vitro*. The rates of multiplication were quite high as those on culture media supplied with growth regulators reported in the literature. Comparison of our results and the other published data shows that application of plant growth regulators seems just to shorten the time period of *Fittonia in vitro* microclonal propagation but does not have any significant effect on multiplication coefficients.

Determination of total phenolics and flavonoids was made; the total content of flavonoids and phenolics was about 2.0–4.5 mg (of rutin or ferulic acid, accordingly) on 1 g of the dry weight of plant (0.20–0.45 % of dry weight). The obtained data showed the significant differences between *in vivo* growing plants with dark-green (#1) and light-green leaves (#2). As to *in vitro* variants of the experiments the mean content of the investigated substances did not change in #1 whereas the significant increase in both phenolics and flavonoids amount was observed in #2 extracts. A significant difference in the amount of flavonoids between studied clones cultured *in vitro* was also detected.

As a result, the system of effective microclonal propagation of *F. albiviens* on hormone-free media was elaborated. The different ability of *in vitro Fittonia* clones to produce investigated biologically-active substances has been stated; the clones with the highest productivity have been identified and will be used in further researches.

Keywords: *Fittonia albivenis*, Acanthaceae, flavonoids, phenolics, *in vitro* culture.

IMPACT OF PLANTS SECONDARY METABOLITES ON CABBAGE PRODUCTIVITY

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Improving the sustainability of vegetable crops to adverse growing conditions is a significant reserve for increasing yields with the already achieved level of intensification of their production. The implementation of resource-saving and especially environmentally safe technologies for the production of vegetables brings to the fore the use of biologically active substances (BASs) of natural origin as growth regulators. It is BASs with their exogenous use that can in low concentrations influence the intensity of the physiological processes in the plants, especially under unfavorable conditions for their growth.

The purpose of this study was to use a complex of biologically active substances isolated from some representatives of the wild flora of Republic of Moldova (family of Plantaginaceae Juss.) as growth regulators and to establish their effect on seed viability, yield and biochemical composition of white cabbage (*Brassica oleracea* L., Brassicaceae Burnett family).

Plants of *Linaria vulgaris* Mill., *Verbascum densiflorum* Bertol., *Linaria genistifolia* L., *Veronica officinalis* L. were collected during the flowering stage, in the period of maximum accumulation of biologically active compounds. From the aerial part of these plants by exhaustive extraction with aqueous ethanol followed by purification of extracts through the adsorption-distribution chromatography on columns with a sorbent, there were obtained the various complexes of BASs. The isolated complex fractions were characterized using methods of spectral and chromatographic analysis and tested in laboratory conditions for their biological activity by pre-sowing soaking the seeds of white cabbage with low germination (62.4 %). The certified natural growth regulator Ecostim, contained the tomatoside, the steroid glycoside of furostanol series, was used as a reference preparation.

In field condition, the cabbage seeds were soaked in 0.01 % aqueous solutions of bio-regulators, which showed the greatest positive germination effect during laboratory testing. The use of the preparation Ecostim and the complex of bio-regulators from *Veronica officinalis* for pre-sowing seed soaking created the most favorable conditions for the growth and development of white cabbage, significantly increasing the seed germination, stimulating the processes of root formation of seedlings and its survival.

The ability of these bio-regulators to improve the production process of white cabbage was established. Seed treatment with the solutions of Ecostim and complex of bio-regulators from *Veronica officinalis* contributed to an additional 11.1 tons and 6.7 tons of standard cabbage heads per hectare, respectively. It was shown that the pre-sowing treatment of seeds also had a positive effect on the biochemical indexes of cabbage, increasing the content of vitamin C and sugars.

The performed research, its scientific and applied results allowed us to recommend the pre-sowing seed treatment with solutions of the preparation Ecostim and the complex of bio-regulators from *Veronica officinalis* as an element in the technology of cabbage growing.

Keywords: bioregulator, Ecostim, *Veronica officinalis* L. white cabbage, yield.

**SCORZONERA HISPANICA L. – PROMISING BIOTECH CULTURE****Olga Bulko, Lyudmila Liozhyna**

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In recent decades, diseases associated with unhealthy diets, such as obesity, diabetes, atherosclerosis, and others have become widespread among the world's population. In this regard, the issues of revising the usual diet and introducing new or undeservedly forgotten healthy food products are of particular relevance. Black salsify *Scorzonera hispanica* L. from the family *Asteraceae* Bercht. & J. Pres is just such an undervalued plant because its edible root crops contain a significant amount of dietary fiber, which has an insignificant energy value, but regulate the physiological and biochemical processes in the digestive organs, removing harmful substances from the human body. Scorzonera contains soluble fructan –inulin (up to 38 % of the dry weight), which is characterized by a low content of glucose in the molecule. This makes it a particularly valuable alternative source of carbohydrates for diabetics since insulin is not required to digest inulin. In addition, in this plant there is a lot of protein, micro- and macro-elements, vitamins, other bioactive substances, radioprotective and anti-cancer properties are also found. The reproduction of black salsify by seeds is difficult since the seeds lose their germination in the second year, therefore the microclonal propagation of this dietary plant is relevant.

For the introduction of *S.hispanica* seeds into *in vitro* culture, treatment with potassium permanganate, 70° alcohol and 0.1 % HgCl₂ solution was used. Germination was low, about 23 %. The culture medium for reproduction on the basis of Murasige-Skoog (MS) was supplemented with various combinations of plant growth regulators: 6 benzylaminopurine (6-BAP), kinetin (6-furfuryl-aminopurine), indolyl-3-acetic acid (IAA), indolyl butyric acid (IBA), α-naphthylacetic acid (NAA) in a concentration of from 0.1 to 1.0 mg/l. The maximum multiplication factor was observed when plant tissue culture medium was supplemented with 0.5 mg/l 6-BAP (up to 12.3), however, the resulting plants were very small and unsuitable for further passage. In addition, the plant proved to be demanding on the source of iron in the medium, the standard amount of ferrum chelate was insufficient for normal development of scorzonera, and the use of the so-called red iron (ethylenediamine di-2-hydroxyphenyl acetate ferric (Fe-EDDHA)) was also not effective. It was possible to achieve an intensely green, non-chlorotic coloration of plants, only by increasing the content of ferrum chelate by a factor of 2 compared with the standard recipe. The optimal medium for micropropagation of *S.hispanica* was the medium with the addition of 0.5 mg/l of kinetin and 0.01 mg/l of NAA when the coefficient decreased to 7.8, but the obtained microclones were larger, morphologically homogeneous, with a high survival rate when the plants were passaged. Rooting did not occur on the hormone-free medium MS, different concentrations of auxins were tested to stimulate root formation, the maximum number of roots was observed on the medium with the addition of 0.7–0.8 mg/l IBA.

Thus, the conditions were selected for the micropropagation of the *Scorzonera hispanica* – a promising food plant and a source of inulin.

Keywords: *Scorzonera hispanica* L., micropropagation, phytohormones, inulin.



MILLIMETER RADIATION AS A FACTOR INCREASING VIABILITY OF COLLECTION ACCESSIONS OF MEDICINAL PLANTS UNDER *EX SITU* CONSERVATION

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One of the important tasks of plant gene banks includes conservation of the collection accessions of crop plants in *ex situ* collections. During the long-term storage, complex physiological and biochemical processes of aging occur in seeds resulting in a decrease of viability, which in some cases leads to the loss of germinability. Therefore it is vitally important to apply methods of exogenous influence on seeds after their long-term storage in order to stimulate germination.

These studies were conducted to investigate the influence of one of the essential physical factors i.e. millimeter radiation (MMR) on the processes of seed germination of medicinal plants under the conditions of *ex situ* conservation.

Test objects included seeds of safflower (*Carthamus tinctorius* L.) and purple echinacea (*Echinacea purpurea* (L.) Moench). We studied the separate effect of millimeter radiation (wavelength of 5.6 mm; power density of 6.6 mW/cm²; exposures of 8 and 30 min) and combined effect of MMR and low temperature (LT) (2–4 °C) on seeds after their long-term storage in the plant gene bank. Factors were applied in direct (MMR+LT) and reverse (LT+MMR) combinations with the purpose to reveal protective and reparative effects of millimeter radiation on old seeds. If MMR is applied to seeds before they are exposed to unfavorable factor, their increased viability will be indicative of the protective effect on seeds; if MMR is applied to seeds after the influence of unfavorable factor, then it will be all about the reparative effect of MMR. Influence of MMR and LT on morphophysiological and biochemical parameters of seeds and seedlings (germinating power and germinability of seeds, radicle length, fresh and dry biomass of seedlings, electrolyte release from seeds, activity of peroxidase enzyme in seedling radicles) was determined in control (fresh seeds) and in experiment (seeds after long-term storage).

These parameters showed stimulation of growth processes in seeds and seedlings following treatment of seeds with millimeter radiation. The use of MMR exposure of 8 and 30 min for safflower seeds resulted in an increase of seed germinability by 1.2 and 1.3 times, for echinacea seeds – by 5.8 and 7.5%. Radicle length of safflower seeds was 1.4 times higher than control after MMR exposure of 30 min, radicle length of echinacea seeds was 1.2 times higher. Values of dry biomass of safflower and echinacea seedlings after MMR exposure of 30 min were 1.2 and 1.5 times higher than control, respectively. Protective and reparative effects of millimeter radiation were observed, especially with 30-min exposure. Quantitatively, the protective effect of MMR manifested better; both effects indicate the increase of seed viability with the help of MMR during the period when the seeds are affected by abiotic stress (LT).

This method can be recommended for the increasing of seed viability of some medicinal plants under *ex situ* conservation.

Keywords: medicinal plants, millimeter radiation, germinating power, germinability, radicle length, peroxidase activity.



COLLECTION OF SAMPLES OF *ORYZA SATIVA* L. AS A SOURCE OF VALUABLE TRAITS IN BREEDING FOR PRODUCTIVITY AND ADAPTABILITY

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Rice is one of the staple crops worldwide. In Ukraine, rice is cultivated in the most northern zone of rice growing. Introduction of valuable rice cultivars and varieties via exchange scientific collaboration is a crucial branch of work at the Institute of Rice. The collection encompasses 789 rice samples that come from 30 countries. It not only reflects genetic diversity of *Oryza sativa* L. but is also valuable for research and education as it contains sources and donors of traits determining yield and its components, plant development rate, resistance to unfavorable factors and product quality. On the basis of samples from this collection, the following varieties were created and included in the State Register of Plant Varieties Suitable for Dissemination in Ukraine: Premium, Vikont, Marshal, Lazurit, Korsar. In turn, Konsul, Fagot, Galeon, Zenit from 8 to 10 t/ha cultivars have been undergoing evaluation by state scientific expert since 2016.

The aim of this research was to study productivity and adaptability of the collection of samples of rice in order to identify the most valuable ones for further breeding. Characterization of rice samples imported in 2016–2018 that are outstanding in terms of yield and its components under both favorable and unfavorable weather conditions was performed. 27 studied rice samples originated from multiple countries (Kyrgyzstan, Uzbekistan, Spain, Italy, France, Egypt, China, India, the U.S.A., the Philippines) entailed early-ripening from 110 to 115 days, mid-season from 120 to 125 days and late-ripening (>125 days) rice cultivars that belong to two subspecies: japonica and indica.

To select starting materials, duration of vegetation season of rice samples from different eco-geographical groups (European, African, Latin American, Eastern, Filipino, South Asian) was analyzed and determined to be in the following ranges: from 102 to 130 days, from 146 to 155 days and from 122 to 140 days for the European, African and Latin American groups, respectively. Rice samples were sorted in clusters depending on the level of productivity and its components. 4 early-ripening, 8 mid-ripening and 15 late-ripening varieties that possess the most valuable breeding and economic features were selected. In particular, Iskander, Hultahon, TR 556-7-1-1, TR 653-1-2-2-1, JR 67411-174-2-2 – on the basis of five traits; Long Dao 5, Long Zing 31, Long Zing 33, TR 787-10-1, Giza 181, Baldo, Volano, Lotto – on the basis of four traits. These samples combine high productivity of panicle from 3.0 to 4.9 g with high grain number per panicle from 130 to 155 and high of whole rice kernels from 85 to 94 %.

Recently, studies on the productivity potential of rice genotypes under conditions of drip irrigation have commenced. Furthermore, domestic rice varieties that can yield up to 11.9–13.4 t/ha have already been determined – Konsul and Fagot. Consequently, conducted research enabled identification of sources and donors of complex traits, which can be used for the development of new rice cultivars with high yield capacity as well as grain and grit quality.

Keywords: rice, sample, trait, high yield, grain quality, plant breeding.

Acknowledgments

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FEATURES OF BIOCHEMICAL COMPOSITION OF HONEYSUCKLE FRUITS OF THE ALTAI REGION

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M.A. Lisavenko Scientific Research Institute of Horticulture of Siberia ("SRIHS") actively conducts research and selection of blue honeysuckle (*Lonicera caerulea* L.). The selection is based on purposeful hybridization of genetically different samples, with the aim to create highly productive varieties. Honeysuckle forms such as *L. altaica* Pall., *L. kamtschatica* Pojark., *L. edulis* Turcz. ex Freyn, *L. turczaninovii* Pojark. and others are involved in the hybridization. It is well-known that species and subspecies of honeysuckle differ significantly in the content of basic chemical compounds in their fruits.

The present research studies the content of nutritive and biologically active substances in the cultivars and hybrids of honeysuckle of SRIHS in the Forest-Steppe zone of the Altai Region. The aim of the research is to determine the sources of the high content of nutritive and biologically active substances, to select the parent varieties for purposeful cross-breeding and, as a result, to create highly valuable cultivars.

The research object is fresh ripe fruits of local (selected by SRIHS) and introduced honeysuckle cultivars and hybrids. The content of the following chemical compounds is measured: soluble dry substances (SDS) (refractometric method), soluble sugars (direct titration of aqueous extracts), organic acids (titration of extracts with 0.1 H alkaline solution), ascorbic acid (vitamin C) (indophenol and potentiometric titration), pectin substances (titrimetric method), bioflavonoids (spectrophotometric and colorimetric methods).

The research concludes that in the Altai Region the fruits of honeysuckle contain 9–17 % of SDS, 6–12 % of sugars, 1–5 % of organic acids, and the sugar-acid ratio is between 1.5 and 9 relative units. Fruits of the following cultivars and hybrids have a high content of SDS (more than 14%) and sugars (more than 10%): Selena, Assol, Ognenniy Opal, Berel, Barkhat, Narimskaya, Andarma, 2-5-33, 3-303-82, 19-34-94, 19-83-94, 19-34-94, 20-70-94, etc. The content of vitamin C in the fruits can reach 50 mg/100g (cultivars Zolushka, Gerda, Ognenniy Opal, Assol, Berel, some hybrids). The content of pectin is between 0.1–0.9 %, the content of pectin substances is between 0.4–1.9 %. In this regard, the best cultivars and hybrids are Barkhat, Zolushka, Ognenniy Opal, Berel, 20-96-94, 21-76-94, etc. The content of bioflavonoids varies between 800–2300 mg/100g. The cultivars Berel, Bakcharskiy Velikan, Kasmala, Kalipso, Selena, Yumis, hybrids 36-23-07, 36-1-07, 4-21-09, 2-36-08, etc. are the most valuable in this regard (1500 mg/100g and more).

The research also concludes that the varieties of honeysuckle *L. kamtschatica* are the biggest source of high content of nutritive substances; the best sources of biologically active compounds are the varieties of honeysuckle *L. altaica*.

Keywords: honeysuckle, fruits, biochemical composition.



FUNCTIONAL PRODUCTS ARE A GUARANTEE OF HEALTH

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In the modern world due to frequent stress and unhealthy diet, many people are faced with diseases of a different nature. The imbalance of nutrition is aggravated by unfavorable environmental conditions. The nutrition of the majority of the adult population does not comply with the principles of healthy nutrition due to the consumption of food products containing large amounts of animal fat and simple carbohydrates, as well as due to a lack of vegetables and fruits, fish and seafood in the diet. This leads to an increase in overweight and obesity, the prevalence of which in the last 8–9 years has increased from 19 to 23 %, increasing the risk of developing diabetes, cardiovascular diseases, and other diseases. A functional food product (FFP) is a special food product intended for systematic use in the composition of food rations by all age groups of the healthy population. One of the most important and promising areas of development of the food industry is the creation of safe and, at the same time, high-grade specialized products, in terms of composition and consumer properties, including biologically active additives (dietary supplements).

This is due to the need to ensure the diet of modern man irreplaceable nutrients. Available domestic and foreign studies indicate a chronic nutritional deficiency of vital vitamins, minerals, some minor food components, which is explained by the urbanization of society, an increase in the share of refined, cooked and stored food. The aim of the research is the development of the technology of bioprotective functional food products based on modified plant materials.

To achieve this goal, it is necessary to solve the following tasks: to justify rational technological approaches to the creation of food products of paste-like and dry forms using physiologically valuable ingredients of soybean seeds, wild berries raw material. Scientific novelty of the work: the process of structure formation in the soy protein dispersion system was studied when using as a coagulant a complex of organic acids contained in wild berries raw material; dependencies were established characterizing the process of obtaining paste-like plant compositions of a given composition and properties. Based on the analytical review of the literature and patent sources, technological approaches to the creation of pasty and dry forms of food using physiologically valuable components and ingredients of soybean seeds, wild berries raw materials are determined.

Dependencies characterizing the formation of the structure and properties of food systems containing physiologically valuable components and ingredients of soybean and berry raw materials, on the basis of which the optimal parameters for the production of plant compositions are substantiated, are established.

Keywords: functional products, nutrition, health.

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PROBLEMATIC ASPECTS OF BEEKEEPING AS A CONSOLIDATED PRESERVATION OF BIOLOGICAL DIVERSITY OF UKRAINE

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Socio-economic development in Ukraine should be directed for harmonization ecological and economic space and the needs of each individual and society at large taking into account everyday problems and without threat to interests and the requirements of future generations. Beekeeping is a critical component of modern agriculture.

The purpose of work – using different means, in particular, lectures, excursions, consultations to draw attention to the problem the disappearance of bees, to inform the population about their important role. The National Museum of Beekeeping operates on the territory National Scientific Center “Institute of beekeeping named after P.I. Prokopovich”. The museum is qualified to keep historical past and propagandize modern technologies of production of apiproducs, recognizing the value of bees as pollinators. In the largest hall of the museum, the displays and pictures show the content and peculiarities of basic stages in the development of beekeeping – stump and frame apiculture. There are many displays are exhibited there on podiums: the simplest hives, hives placed in hollows of trees, objects made of straw. There is an exposition “Apicultural Products”, their application in medicine, at home, industry, and economic activity in a separate pavilion. One of the departments is devoted to the melliferous herb of Ukraine, there is characteristic of their nectar productivity, calendar of their flowering. Honey, pollen, royal jelly, and propolis have been a part of healthful remedies for centuries. Honey and propolis have significant antibacterial qualities. Royal jelly is loaded with B vitamins and is widely used overseas as a dietary and fertility stimulant. Pollen is high in protein and can be used as a homeopathic remedy. Apitherapy is the use of bee products for treating health disorders. Even the bees’ venom plays an important role here –in bee-sting therapy. Honey plants – the only natural source nectar and pollen for a bee. They include wild species, agricultural and forest crops. Any gardener recognizes the value of pollinating insects. Insects perform an essential service in the production of seed and fruit. The survival of plants depends on pollination. Sixty percent of the fruits and vegetables we rely on to feed our families need honey bee pollination. But today, the value of keeping bees goes beyond the obvious. In many areas, millions of colonies of wild (or feral) honey bees have been wiped out by urbanization, pesticides, parasitic mites, and a recent phenomenon called Colony Collapse Disorder. Collectively, these challenges are devastating to the honey bee population. 'The reduction of insect colonies which pollinate the flowers of plants, including bees, is threatening the global food situation', UNEP experts warn. United Nations Food and Agriculture Organization (FAO) figures, that bees and other insects pollinators play an invaluable role in ensuring global food security. Almost a third of all food produced in the world - every third spoon - depends on pollination.

Inference. An active position of the state is required in addressing beekeeping. Funding for honey bee research is more critical than ever. One measure beekeepers have been taking is to keep bees as healthy as possible – improve nutrition and reduce stress. Good nutrition is vital to the overall health of the colony.

Keywords: beekeeping, apiculture, honey plants, saving the bees.

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**SUPERFAMILY *APOIDEA* IN ORGANIC AGROLANDSCAPES OF WINTER WHEAT****Tetiana Grabovska**

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Bees play a key role in pollinating plants and are very sensitive to adverse factors, which is why they are used as indicators of the environment. Biodiversity of agrocenoses is an indicator of the degree of their anthropogenic transformation and stability. In organic farming, unlike conventional, pesticides, agrochemicals and artificial fertilizers, GMOs are not used. It is close to natural conditions, but remains artificially created. Therefore, in such agrolandscapes, the qualitative and quantitative composition of the biocenose and, accordingly, environmental indicators, which include *Apoidea*, are changing.

The aim of the research was to identify the diversity of superfamily *Apoidea* in the organic agrolandscapes of winter wheat in the Right-Bank Forest-Steppe of Ukraine.

The research was carried out at the Skvyra Research Station for organic production; its organic fields have been certified since 2013 and are typical for this natural zone. Insects were gathered using the standard entomological aerial insect net (20 waves, 5 repetitions) on the organic fields of winter wheat (phase BBCH 85). Control was the fields of winter wheat with conventional technology. The area of the organic field is 6.12 hectares; studied areas are 100 m². *Apoidea* representatives were detected in agrocenoses, ecotones between fields and forest shelter belts, as well as in forest shelter belts.

Representatives of families *Halictidae* (3 species / 100 m²) and *Colletidae* (1 species / 100 m²) were found on the organic field of winter wheat. In the ecotones between the field and the forest shelter belt we found families *Crabronidae* (1 species / 100 m²) and *Megachilidae* (2 species / 100 m²). Families *Andrenidae* (1 species / 100 m²), *Halictidae* (4 species / 100 m²), *Megachilidae* (2 species / 100 m²) and *Colletidae* (1 species / 100 m²) were in the forest shelter belts near the organic field. In the conventional field, families *Crabronidae* (2 species / 100 m²), *Andrenidae* (1 species / 100 m²) and *Colletidae* (1 species / 100 m²) were found.

Bees of these families have a variety of nesting behavioral forms and trophic relations. In the organic agrolandscape there were representatives of genera *Philanthus* and *Cerceris*, which have a different food specialization. However, their larvae are entomophagous and harm the bees. Also, there were important pollinators of plants – genera *Hylaeus* and *Andrena*. In the forest shelter belt near the organic field with winter wheat, the largest number of families and representatives of bees were found, 50% of which are *Halictidae*.

Organic farming allows biodiversity to be sustained. However, agrocenoses of winter wheat are artificially created by human semi-natural systems, which should contribute to the sustainability and productivity of agroecosystems. Therefore, amount of bees are less there than in the adjoining forest shelter belt with a more complex structure of biotopes.

Keywords: *Apoidea*, organic farming, winter wheat, biodiversity.

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VARIATIONS IN SEEDS MORPHOMETRICAL CHARACTERS OF *DIOSPYROS LOTUS* L.**Olga Grygorieva¹, Svitlana Klymenko¹, Yulia Vinogradova², Ján Brindza³**¹M.M. Gryshko National Botanical Garden of the National Academy of Sciences of Ukraine, Kyiv, Ukraine; E-mail.: olgrygorieva@gmail.com²N.V. Tsitsin Main Botanical Garden of Russian Academy of Sciences, Moscow, Russian Federation³Slovak Agricultural University in Nitra, Nitra, Slovak Republic

The study of seed morphology is an integral part of breeding work. Morphological characters are used to determine the taxonomic status of samples, as well as to identify duplication of germplasm collections, to assess genetic diversity, and for correlational study between morphology and other important agronomic characters.

The aim of this study was to determine the variability of some morphometric characters of seeds within an introduced population of *Diospyros lotus*. The results obtained will help us to assess the diversity and stability in the genetic pool of the studied species formed in the secondary cultigenous area.

The objects of the research were seeds plants of *Diospyros lotus*, which are growing into Arboretum Mlynany (Slovakia) from the seeds acquired in 1970 from Korea, China and Japan. There were 31 genotypes tested in an experimental study in 2018. Pomological characteristics were made on a total of 100 seeds per genotypes. In the study only one plant (tree) used for per genotype. Seeds were taken from ripe fruits in the autumn (November). Fresh seeds were sterilized with distillate water and ethanol and cut along the groove. Examined morphological parts were isolated and measured using a stereomicroscope Zeiss Discovery V 12.

The morphometric parameters were following: seed length 10.41 (2.61–13.85) mm, seed width 6.18 (1.35–8.25) mm, embryo length 5.85 (2.48–9.68) mm, radicle length 3.08 (1.05–6.14) mm, radicle diameter 0.81 (0.23–1.25) mm, cotyledon length 2.77 (1.42–4.42) mm, cotyledon width 1.54 (0.50–2.54) mm. The shape indexes of seeds and cotyledon varied 0.184 (0.93–4.72) and 1.69 (0.39–2.37), respectively. The analysis of the coefficient of variation showed the difference in variability of morphological signs between *Diospyros lotus* samples. The most variability signs are the cotyledon width (21.40 %) and radicle diameter (19.46 %). The results indicated very high correlations between the embryo length and the cotyledon length ($r = 0.953$), embryo length and cotyledon length ($r = 0.941$). High correlations observed between radicle length and cotyledon length ($r = 0.801$) and seed length ($r = 0.768$), seed width and radicle diameter ($r = 0.703$).

Our results can be used to plan future research on the cultivation of *Diospyros lotus* L. They will also include in the 'key' for identifying and describing new cultivars.

Keywords: *Diospyros lotus* L., seeds, morphometric parameters.

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SPECIFICS OF THE ASSIMILATION SURFACE OF COLUMNAR APPLE-TREE

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Given that the productivity of garden agrocenosis, its yield is determined by the intensity and productivity of photosynthesis, which depend on the anatomical structure of leaves and their phytosanitary status, as well as the number of leaves on the plant, environmental factors, the study of the listed properties in the columnar apple trees is relevant.

The aim of this study is to determine the anatomical structure and clean productivity of photosynthesis (CPP) of leaves, the optimal area of assimilation surface required for the annual and generous fruiting of columnar apples.

The research had been conducting during 2017–2018 in the Kyiv region. The net productivity of photosynthesis was determined by V. Koshelev's method; the anatomical structure of leaves – according to V. Khrzhanovsky, indicators of photosynthetic activity – according to O. Ovsyannikov and R. Kudryavets. Seven columnar cultivars in plantings of primary varietal apple were the objects of research.

In the leaves of all the examined cultivars, three layers of palisade tissue observed, the thickness of which is different in grades. Thus, according to control (Bolero) the Favorite, Tantsivnytsia, President sorts it was significantly less, while the biggest has been present in Bilosnizhka leaves (124.1 microns). The ratio of palisade tissue to spongy was 1.13–1.24.

The total leaf area in the trees of the studied cultivars was 0.45–3.3 m²/tree. The formation of the fruit weighing 100 grams in the cultivar Bilosnizhka provides the largest area of leaf surface – 795.12 cm². Below, relative to control, this indicator is in the cultivars of Tantsivnytsia, Valiuta, and President. Trees' cultivars of Tantsivnytsia forming 100 grams of fruit provides 75.63 cm² of leaves, that corresponds to 5.6 leaves. While in Valiuta and President cultivars, the growth and development of one fruit on average occurs in the presence of 17 leaves.

The highest clean productivity of photosynthesis level of leaves was observed in the plants of Valiuta, Bilosnizhka, and Favorite cultivars – 9.1–13.9 g/m² per day. In the Bolero, Sparta and Tantsivnytsia cultivars, the rate of dry matter accumulation is slightly lower (8.3–8.7 g/m²). The foliage of complex fruit formations of the trees of the studied cultivars varied depending on the age of the trunk area. Thus, in apple trees of Tantsivnytsia cultivar, the largest area of leaves was 15-year-old fruit formations, while Sparta cultivar has 19-year-old. On the President cultivar trees the uniform foliation of fruits on 4-10-year sections of a trunk has noted (1546.4–1585.9 cm²).

According to the results of the study, the varietal difference of the parameters of assimilation surface and the main parameters of its photosynthetic activity were revealed. The comprehensive assessment of the morphophysiological components has made it possible to establish that the studied cultivars differ in the potential productivity and efficiency of its realization in the economic harvest.

Keywords: columnar apple, cultivar, anatomical structure of leaves, leaf area, clean productivity of photosynthesis.

MORPHOLOGICAL AND ANATOMICAL FEATURES OF LEAVES STRUCTURE SPECIES OF GENUS *THYMUS* L., INTRODUCED IN BOTANICAL GARDEN OF IVAN FRANKO NATIONAL UNIVERSITY OF LVIV

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Introduction of local and outlander flora species have great meaning in the extension of an assortment of medical plants. Species of genus *Thymus* L. are rich in essential oils that demonstrate antimicrobial, antioxidant features and are used in medicine, aromatherapy, cosmetology, and cooking.

The aim of work is the exploration of morphological and anatomical features of the structure of leaves of species of genus *Thymus*, which are exhibited at a 'medical plants' collection in Botanical Garden of Ivan Franko National University of Lviv, namely *Th. vulgaris* L., *Th. zygis* L. and *Th. camphoratus* Hoffmanns. Link (Mediterranean species); *Th. Callieri* Borb. and *Th. serpyllum* L. (Ukrainian species). Anatomical structure studies of a lamina of leaves were conducted with the help of 'Leica DM 500' microscope.

Raw of species of genus *Thymus* is aboveground mass on a stage of flowering. Pubescent leaves and the presence of essential oils for its identification structure of leaves are used. In explored species leaves are contrary crisscrossed, in the lower part of sprout they are small petioled and upwards they become sedentary. The pattern of the lamina is changed in a similar way. In all species, these laminas are wrapped up and only in *Th. serpyllum* they are straight.

Pubescence of leaves is made of simple, non-glandular hairs and glandular essential oils (capitate and peltate) trichomes. In *Th. vulgaris*, *Th. callieri* and *Th. serpyllum* leaves are green, over the edge of lamina they have pubescence of long, 5–7 cellular impacted hairs and between them short, 1–3 cellular hairs are situated. Simple hairs also are situated along veins as well. Leaves of *Th. zygis* are grey because of thick pubescence, especially from below. It is created of a single cell, upwards sharpened hairs, and two-cell geniculate curved hairs, where three cellular hairs can be met. In all of the species capitate trichomes with unicellular gland, sedentary or unicellular stalk are situated on the surface of a lamina. Except this, on the surface of lamina essential peltate hairs with multicellular gland are situated. Its amount is bigger on the abaxial surface of a leaf than on an adaxial surface. In *Th. camphoratus* there are much more trichomes than in all of the other species.

Cells of the upper epidermis of *Th. vulgaris* are oval, sometimes vaguely pentagonal from the upper side and with weakly winded anticline walls from inside. In *Th. zygis* they are multi oval. *Th. callieri* and *Th. serpyllum* has epidermis cells with winding walls. Stomata apparatus is of a diacetate type. The amount of stomata's is bigger from the abaxial side than from adaxial surface leaves.

Essential oil fittings are situated above big veins in mesophile of a leaf. Their numerous cells contain thick cytoplasmic content, only *Th. camphoratus* does not contain inner fittings.

Summing it up, features that are listed above can be used for identification of medical raw of explored essential species of genus *Thymus*.

Keywords: *Thymus* spp., morphology and anatomy, leaves, trichomes.



DIVERSIFICATION OF TRICHOMES OF CRUCIFEROUS PLANTS (BRASSICACEAE BURNETT) OF THE FLORA OF UKRAINE

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Cruciferous trichomes have long been described and used in taxonomy primarily for the delimitation of varieties, species or genera. Only K. Prantl considered the configuration of hairs as important diagnostic features of tribes and subtribes. The use of a scanning electron microscope (SEM) has opened up new opportunities for trichomes research. New hair types have been described. There is no unified classification of structural diversity of trichomes in the Brassicaceae family. For example, E. Dennert (1885) identified three, C.R. Metcalfe and L. Chalk (1979) – fifteen, and M.A. Beilstein, I.A. Al-Shehbaz and E.A. Kellogg (2006) – four types of trichomes.

The aim of the work was to investigate the structural diversity of trichomes of all species of the Brassicaceae Burnett (251 species) of the flora of Ukraine.

Materials of the herbarium collections (KW, DNZ, JALT, LW, CWB, KWHA, LE, MW) and literature data were used. Small fragments of leaves and pedicels were glued to the tables with double adhesive tape and covered with gold. Samples were examined with SEM JSM-6060 LA (JEOL, Japan).

A new classification has been proposed, which includes five types (simple unbranched, stellate, malpighiaceus, dendroid and furcate) and 12 groups of simple hairs, as well as two types (multicellular and unicellular) and two groups of glandular trichomes. It was found that hairs are absent in 16 species of 11 genera of Brassicaceae (*Cakile* Miller, *Cochlearia* L., and *Armoracia* G. Gaertn., B. Mey. & Scherb. etc.) of the flora of Ukraine. These species are components of wet, over-wetted, or saline biotopes. Pubescence of 105 species of 20 genera (*Crambe* L., *Alliaria* Heist. ex Fabr., *Sobolewska* M. Bieb., and *Sisymbrium* L., etc.) is an optional feature. It is formed mainly by simple hairs. The ecological range of these species is quite wide – semi-humid, humid and saline biotopes. Stellate hairs are especially peculiar to xerophilous species of the tribe Alysseae, only in *Lobularia maritima* (L.) Desv. there are malpighiaceus, and furcate trichomes are often observed in combination with simple ones (*Arabidopsis* Heynh., *Turritis* L., *Strigosella* Boiss. etc.). Heteromorphic pubescence consisting of simple and glandular trichomes are of the genera *Bunias* L. *Chorispora* R. Br. ex DC., *Clausia* Trotzky, *Hesperis* L. and *Matthiola* W.T. Aiton. These genera form one big superclade, according to the data of molecular phylogenetic studies.

Our results demonstrate that cruciferous of the flora of Ukraine have very diverse of trichomes. The type of trichomes and the characteristics of pubescence are persistent generic, sectional or species-specific, and some tribes are also diagnosed. A large diversity, of trichomes, was formed, possibly as a result of the evolution of the ancestor type of Brassicaceae s. l. in very different cryo-xerophilic biotopes of the continental climate.

Keywords: Brassicaceae, trichomes, SEM, morphology, flora of Ukraine.

LIFE FORMS OF BRASSICACEAE BURNETT SPECIES OF THE FLORA OF UKRAINE

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Information on the life-forms of Brassicaceae Burnett species is incomplete and was obtained by the authors at different times as the result of using different approaches, principles, and characteristics. Specifically, the life forms of cruciferous flora of Ukraine have not been studied.

The aim of this study was to determine the diversity of biotypes, life-forms, and biomorphs of cruciferous of the flora of Ukraine according to the same scheme, and on the basis of the same complex of characters.

The concept of morphological-geographical monotype standard of the species is used. Objects of the study: 251 species from 74 genera of Brassicaceae family of the flora of Ukraine. We used the results of the original field research, the materials of herbarium collections KW, DNZ, JALT, LW, CWB, KWHA, LE, MW (Index Herbariorum <http://sweetgum.nybg.org>) and literature data. The biotypes and the life-forms are described according to Raunkiaer classifications (1934) and Serebryakov (1962), respectively. The biomorphs are defined according to Serebryakov system-hierarchical principle (1962).

The resulting spectrum of Raunkiaer biotypes is as follows: therophytes (102 species, 40.6 %), hemicryptophytes (101 species, 40.2 %), chamaefites (33 species, 13.1 %), geophytes (12 species, 4.8 %), helophytes (two species, 0.8 %) and hydrophytes (one species, 0.4 %). Cruciferous life-forms (according to their duration) of the studied flora are fairly uniform: monocarpic herbs (134 species, 53 %) and herbal polycarpic (83 species, 33 %) dominate, there are few small subshrubs (33 species, 13 %) and very few amphibious and floating herbs (only *Nasturtium officinale* WT Aiton, *Rorippa amphibia* (L.) Besser and *Subularia aquatica* L. (problematic species of Ukrainian flora), respectively). According to the system-hierarchical classification developed by us, the range of cruciferous biomorph diversity is wider compared to such of the biotypes and of the life-forms and divided between 2 divisions, 3 types, 4 classes, 5 subclasses, 4 groups, and 6 sections. Among the studied crucifers there are very much monopodial monocarpics with semi-rosette shoots and taproot (71 species from 39 genera, including *Rapistrum* Scop., *Chorispora* R.Br. ex DC., *Camelina* Crantz, etc.). Much less is there monopodial monocarpics with semi-rosette shoots and caudex (28 species of 10 genera, including *Arabidopsis* Heynh., *Isatis* L., *Raphanus* L. etc.) or with elongated shoots and taproot (22 species of 9 genera including *Lepidium* L., *Meniocus* Desv., *Erysimum* L. etc.).

Our results show that life-forms cruciferous of the flora of Ukraine are a reflection of the adaptation of the primary family types to the conditions of the temperate continental climate, including changes to moisture supply and temperature range and to the man-made environmental change. Mostly they represent the xero-cryophilic evolutionary line of development of the ancestral types of the family.

Keywords: Brassicaceae, biotypes, life-forms, biomorphs, flora of Ukraine.

**COLLECTION OF THE GENUS *CORYLUS* L. IN THE DONETSK BOTANICAL GARDEN****Lyudmila Kharkhota, Elena Vinogradova**

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Caryocarpous trees are deserving of valuable and ornamental crops. The dendroflora of the Donetsk region with moderately continental dry climate of south steppe and high anthropogenic environmental pressure includes the only nut-bearing shrub species *Corylus avellana* L. confined to ravine oakeries.

We aimed at studying the up-to-date condition of the collection of the genus *Corylus* L. from the Donetsk Botanical Garden (DBG) and evaluation of growth prospects of hazelnut species, varieties, and cultivars in the region.

According to the plant number, the most representative species in the DBG's collection is *C. colurna* L. – the only tree hazel occurring in the territory of the former USSR and listed in the Red Book of the Russian Federation. The total of 500 trees aged 40–45-years (up to 12 m high, trunk diameter up to 50 cm) successfully grow and annually fruits in DBG. The collection also includes decorative varieties of *C. avellana*: *C. a. f. atropurpurea* Petz. & G.Kirchn., *C. a. f. urticifolia* (DC.) C.K. Schneid. and *C. a. 'Contorta'*. *Corylus avellana* f. *atropurpurea* annually fruits abundantly: the average kernel weight is 0.55 ± 0.05 g, kernel yield is 47 %, hardly separable from the shell. *C. a. 'Contorta'* yields single nuts; in *C. a. f. urticifolia* fruits are absent.

The collection of hazelnut cultivars formed in 1997–2001 with planting material obtained from dendrological parks and forestries of Ukraine (Donetsk, Kirovograd and Kharkiv region). Over the years, 37 cultivars and hazelnut hybrids were introduced for trial. Today the collection includes 18 cultivars and hybrids. The layout of a plot is 4×3 m, each cultivar represented by 3–4 plants. The main reasons for loss of many cultivars are drought and insufficient agrotechnical tending in the first years.

In the region, the varieties from the present collection complete annual cycle of development. The growing season begins at the end of the first decade of March – at the beginning of the second decade of March, flowering is in the third decade of March. The vegetation period is 207 to 215 days. Earlier ripening of nuts was observed in cultivars Bashmachok and Serebristy (III decade of August), the latest was noted for cultivars Bomba and Sochi hybrid (beginning from II decade of September). The fruit weight and yield vary from year to year in the same cultivars. The most stable fruiting was observed in the cultivars Bashmachok, Bomba, Serebristy, Dokhodny, Urozhainy. The largest fruits are in the cultivar Louise (the fruit weight is 3.58 ± 0.11 g, kernel yield is 39 %). The highest kernel yield (53 %) is registered for the cultivar Bashmachok (kernel weight 0.85 ± 0.03 g), from 44 to 47% in the cultivars Serebristy (1.26 ± 0.07 g), Sochi hybrid (1.00 ± 0.02 g), Urozhainy (1.00 ± 0.05 g), Funduk B-5 (1.00 ± 0.05 g), Bomba (1.02 ± 0.05 g), Borovskoy (0.99 ± 0.13 g), Klinovidny (0.97 ± 0.09 g).

The developmental cycle of hazelnut cultivars trialed in the DBG is complete and their cultivation under regional conditions is recommended. The most promising cultivars are Bashmachok, Serebristy, Bomba, Louise, Dokhodny, Sochi hybrid with large highly decorative nuts and stable fruit bearing. The species of *C. colurna* and ornamental varieties of *C. avellana* are widely applicable in landscaping.

Keywords: hazelnut, *Corylus*, Botanical Garden, cultivars, collection.

DEVELOPMENT OF WAYS TO INCREASE THE CONTENT OF FLAVONOIDS OF DANDELION EXTRACT

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Particular attention is paid to plants with the centuries-old use in folk medicine, including dandelion (*Taraxacum officinale* (L.) Weber ex F.H. Wigg) – a perennial herb of the Aster family (Asteraceae Bercht. & J.Presl). Dandelion is rich in vitamins A, B₂, C, E, PP, resin, bitter glycoside taraxacerin, manganese, iron, calcium, phosphorus, and proteins. Also, it was found that they contain a large number of biologically active substances, such as carotenoids, choline, nicotinic acid, saponins, thiamine, flavonoids, terpene alcohols, as well as trace minerals. In dandelion flowers, 45 biologically active substances were identified, including amino acids, flavonoids, sugars, tocopherols, sterols, and coumarin. Flavonoids have antioedematous, antispasmodic, antihistamine, anti-inflammatory, antioxidant, diuretic, radioprotective, and antitumor properties. The purpose of the work was the extraction of flavonoids from a dandelion. Dandelion plant raw material was harvested in spring during the period of mass flowering; it is known that during this period most of the biologically active substances accumulate in the flowers. To extract biologically active substances from plant raw materials, various types of electromagnetic irradiation were used. The first stage was extraction from the aerial parts of dandelion (flowers). It is known that the extraction process of plant raw materials is influenced by a number of factors that must be taken into account when selecting extraction conditions: the degree of grinding, the difference in concentrations, extraction time, the temperature of the extractant, and nature of the extractant.

The choice of the extractant depends on the hydrophilicity of biologically active substances (BAS) found in the dandelion flowers. Most of the biologically active substances of dandelion flowers are hydrophilic, so it is advisable to use water as an extractant. This will provide a sufficient yield of nutrients, and therefore the extraction was carried out using distilled water at a temperature of 20±2 °C for 30 minutes, choosing the ratio of plant raw materials to extractant (distilled water) of 1:20 and the degree of grinding no more than 2 mm. Such ratio ensures the optimum yield of biologically active substances (BAS) from plant raw materials. For greater extraction of biologically active substances from plant raw materials, dandelions were exposed to electromagnetic irradiation. The extraction of flavonoids from dandelion flowers was carried out as follows: 1 g of crushed raw material (the degree of grinding 2 mm) was placed in a 25 ml test tube, 20 ml of distilled water was added to each one, the extracts were kept at a temperature of 20 °C for 30 minutes and then irradiated. Dandelion flower extract was irradiated under standard conditions by using electromagnetic irradiation at an extremely high frequency (EHF) (57–68 GHz) and ultrasound (800–860 kHz) for 5, 10, 15, 20, 25 minutes. Control samples were kept under the same conditions without irradiation. The determination of flavonoids was carried out according to standard methods. Having analyzed the data, it was concluded that the most effective was ultrasound irradiation for 15 minutes.

According to the data, the control sample contained 0.0207 % flavonoids. It was established that when processing extracts using ultrasound for 15 minutes the amount of flavonoids was 0.0277 %, which is 2 times more than in the control samples. It was established that irradiation of extracts at an extremely high frequency allows to remove 2 times more flavonoids.

Keywords: dandelion (*Taraxacum officinale*), biologically active substances, flavonoids, electromagnetic irradiation.



ORNAMENTAL HERBACEOUS INTRODUCENTS OF ERGASIOPHYTES RIGHT-BANK FOREST-STEPPE OF UKRAINE

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One of the directions of plant use has long been the use of cultivating ornamental species. Their introduction in the Right-bank Forest-Steppe of Ukraine can be tracked by literary sources, catalogs of botanical establishments from the XXVIII–XIX centuries. Subsequently, among the introducents, the species that now form a group of ergasiophytes.

The object of our research is herbaceous ornamental plants, which not only show a tendency to spread beyond introductory plots and flower gardens in botanical gardens, parks, farmland but also belong to invasive or potentially invasive species within the limits of Cherkasy, Vinnitsa, Kyiv regions of Ukraine.

According to our observations in 2016–2018, the most dangerous decorative ergasiophyte in the Right-bank Forest-Steppe of Ukraine is *Solidago canadensis* L., which extends not only to Ruderal habitats of herbaceous perennials on poor soils (C 1.2.1.), but threatens the change in the cohotic structure of natural groups of Meadow steppes on chernozems (T 1.3.2.). Ergaziofit *Echinocystis lobata* (Michx) Torr. et Gray, in addition to Ruderal habitats, has spread to unpolluted, Herbaceous nitrophilous fringes of lowland rivers (B 4.1.6.). The invasive species of *Asclepias syriaca* L., *Helianthus tuberosus* L., *Phytolacca americana* L., *Saponaria officinalis* L., *Symphotrichum novi-belgii* L. are noted by us as part of the ruderal biotope groups, in the vicinity of the Right-bank Forest-Steppe of Ukraine settlements.

The stable tendency to spread near ornamental cultivated biotopes (C 2.2.3 Flower Garden) in the Right-bank Forest-Steppe of Ukraine has been noted in the following species of ergasiophytes: *Centaurea dealbata* Willd., *Duchesnea indica* (Andr.) Focke, *Heliops scabra* Dun., *Hemerocallis fulva* (L.) L., *Hesperis matronalis* L., *Lupinus polyphyllus* Lindl., *Rudbeckia laciniata* L., *Silphium perfoliatum* L.

Heliops scabra in 2018 we are also registered in a semi-natural biotope (B 4.1.6) in the floodplain of the Umanka river (Southern Bug Basin) near the city of Uman, Cherkasy region (Ukraine). Characteristically, all of these species, with the exception of *Hesperis matronalis*, belong to perennials forming clones, mainly due to hypogeogenic rhizomes. In *Hemerocallis fulva*, there are root bumps that promote vegetative propagation, *Lupinus polyphyllus* forms caudae, so the species is not capable of vegetative propagation, but this is offset by high seed yields. From the ergasiophytes of the annuals, the greatest ability to invasiveness was detected in *Ipomoea purpurea* (L.) Roth.

As a result of our research, it has been found that among the ornamental herbaceous introducents of ergasiophytes of the Right-bank Forest-Steppe of Ukraine there are seven dangerous invasive and eight potentially invasive species that require studying the state of populations and the sources of their distribution in order to avoid further invasions.

Keywords: ergasiophytes, invasive species, control, Ukraine.

MORPHOLOGICAL AND ANATOMICAL FEATURES OF LEAVES OF *CYPRIPEDIOIDEAE***Iryna Krasnenkova, Roman Ivannikov**

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The subfamily *Cypridioideae* consists of five genera: *Selenipedium*, *Phragmipedium*, *Mexipedium*, *Paphiopedilum*, and *Cypridium* (Cribb, 1997, 1998). However, all species *Paphiopedilum*, *Cypridium*, *Phragmipedium* are listed in Appendix 1 of the CITES. Knowledge of their adaptive strategies is essential for their conservation. In the present study, we investigated the leaf anatomical structures and related leaf physiological functions of *Paphiopedilum*, *Cypridium*, *Phragmipedium*.

Cypridium, consisting of 50 species, is widely distributed in temperate and subtropical zones of America, Europe, and Asia. About 32 species are found in China, with most growing in the shade of forest at altitudes above 1,800 m in southwest China (Cribb, 1997; Chen et al., 2005). In contrast to *Paphiopedilum*, the soil layer in areas where *Cypridium* grows is usually contains more nutrients and can store abundant water during the growing season. Most *Phragmipedium* species are either terrestrial, epiphytic or lithophytic orchids.

Paphiopedilum and *Phragmipedium* species were cultivated in a greenhouse. The growing conditions of *Paphiopedilum* were an air temperature of 22–25 °C in the day and approximately 13 °C at night. The leaves *Cypridium calceolus* L. were taken from plants in the natural environment. The study used the following types: *Paphiopedilum bellatulum* (Rchb.f.) Stein, *Cypridium calceolus* L., *Phragmipedium lindenii* (Lindl.) Dressler & N.H. Williams.

Paphiopedilum and *Phragmipedium* is an evergreen plant. Adaxial epidermis cells of *Paphiopedilum* and *Phragmipedium* leaves always had a much larger volume than abaxial cells, but this was not the case in *Cypridium*. In some species of *Paphiopedilum* and *Phragmipedium*, the mesophyll cells were distinctly arranged into palisade and spongy mesophyll layers, but there was no differentiation in *Cypridium* leaves. Both sides of the leaf were heavily cuticularised in *Paphiopedilum* and *Phragmipedium*. Unlike *Paphiopedilum* leaves, cuticles were not obvious on the surface of *Cypridium* leaves. The leaves *Cypridium* had a large number of glandular trichomes that had not been observed for the *Paphiopedilum* and *Phragmipedium*. Stomata were only found on the leaf abaxial surface in *Paphiopedilum*, *Phragmipedium*, and *Cypridium*. The stoma shape was elliptical for all three genera. The guard cell walls of *Paphiopedilum* were heavily cuticularised. The highest density of stomata has been noted for *Phragmipedium*. Stomata on the leaves of *Paphiopedilum* and *Phragmipedium* are deepened into a leaf epidermis. In *Cypridium*, stomata protrude above the surface of the epidermis. In the course of anatomical studies, we recorded chloroplasts in cells of *Cypridium* and *Phragmipedium* switches. *Paphiopedilum* had no guard cell chloroplasts.

Consequently, *Paphiopedilum* and *Phragmipedium* have a set of adaptations to the conditions of the arid environment. *Cypridium* adapts to a medium with enough water and nutrients as evidenced by the anatomical structure of the leaf.

Keywords: *Paphiopedilum*, *Phragmipedium* anatomy, morphology, stomata

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The experiments of the study were accomplished on the basis of the sterile tissue cultures collection of the Tropic and subtropic plants apartment of the M.M. Gryshko National Botanical Garden that from 1999 has a status of National Heritage of Ukraine and is supported by the definite state program.

**CONTENT OF IRIDOIDS IN THE FRUITS OF *LONICERA CAERULEA* L.****Volodymyr Levon**

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To meet the needs of mankind in medical plant raw materials is constantly searching for promising medicinal plants. Recently, much attention is paid to researchers' non-traditional berry crops, among which an important place is occupied by *Lonicera caerulea* L. The fruits of *L. caerulea* exhibit anti-inflammatory, choleric, diuretic and anti-ulcer effect, and the presence of pectin increases the protective functions of the body when the whole body is intoxicated with heavy metals. Eating fresh and frozen fruits are recommended for beriberi, decreased appetite, General weakening of the body, atherosclerosis.

It is known that the medicinal properties of plants are due to the content of active substances that have a certain effect on the human body. Iridoids belong to such compounds. Unlike carotenoids or flavonoids, iridoids are quite resistant and do not break down during prolonged storage or heat treatment of medicinal plants. Due to their bactericidal and antioxidant properties, iridoids can be used as a natural preservative.

Pharmacological studies of iridoids isolated from different plants have shown a wide range of their effects. The most valuable property of iridoids is its ability to be easily oxidized and restored. Iridoids exhibit high biological activity-they provide antimicrobial, anti-inflammatory, diuretic, antimicrobial and sedative action.

The purpose of our research is to determine the content of iridoids in the fruits of *L. caerulea* for their use as medicinal raw materials. The object of research were varieties and cultivars of *L. caerulea*: cultivars 'Skifska' and 'Golube vereteno', varieties No1 and No2 of the collection of the M.M. Gryshko National Botanical Garden of NAS of Ukraine (NBG).

Iridoids content was determined by the method, which is the interaction of iridoid compounds with hydroxylamine to form an oxime. The resulting oxime is capable of forming a coordination compound with trivalent cations of iron, which has an absorption maximum at 512 nm. Control substance – garpagid. Extraction was performed with chloroform-ethanol (5:1) and then, after removing the solvent by extraction with water. Changing the solvent allowed to exclude the impact of related substances results in a hydroxamic reaction.

Comparative analysis of the content of iridoids in different cultivars and varieties of *L. caerulea* from the collection of NBG showed that in fruits that do not have a bitter taste, there are no iridoids. However, bitter forms and cultivars of *L. caerulea* accumulate iridoids. Thus, in the bitter fruits of two varieties and cultivar of *L. caerulea* 'Skifska' their content was 0.08–0.17 %. More iridoids have been found in fruits bitter-fruit cultivar 'Skifska'. The berries of cultivar 'Golube vereteno', which sometimes have a bitter taste, was discovered iridoids, but in a smaller quantity of 0.08 %. This indicates that in the more bitter fruits of *L. caerulea* the content of iridoids is higher. In sprouts and leaves, *L. caerulea* iridoids are not found.

As a result of the studies, it was found that when using *L. caerulea* fruits as a source of medicinal raw materials, it is desirable to use bitter-fruit forms that are characterized by a higher content of iridoids.

Keywords: *Lonicera caerulea*, iridoids, fruits, comparative analysis.



EFFECTS OF DIFFERENT LED LIGHTING ON GROWTH AND NUTRITIONAL QUALITY OF LETTUCE (*LACTUCA SATIVA* L.)

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Lettuce (*Lactuca sativa* L.) is a widespread culture of the *Asteraceae* family, rich in vitamins and minerals. The lettuce is grown all year round in a greenhouse, grows quickly and has great commercial value.

Greenhouse production depends on the use of artificial lighting. In light-culture conditions, only LED (light-emitting diodes) lighting saves energy and enables the combination of light of different wavelengths to select the optimal spectral composition. Salad is sensitive to the quality of light and there are reports that lighting with different spectral composition affects the morphological and biochemical characteristics of the plant (Lin et al., 2013; Zhang et al., 2017).

In this study, we showed the effect of LED lighting of different spectral composition on photomorphogenesis and secondary metabolism of lettuce, variety Lollo Rossa. The plants were exposed to such spectra LED lights: white light (W), monochrome red light (R), monochrome blue light (B), and red/blue ratio lights R / B – 1.3 / 1; 2.3 / 1; 4/1; 1/ 1.7. PPF – 320 $\mu\text{mol quanta m}^{-2}\text{s}^{-1}$, photoperiod – 16/8 h. Luminescent lamps with such characteristics were used as a control: luminous flux – 1050 lm; color temperature – 6500K.

Here, luminescent lighting and white LEDs ensured equal growth and quality of the product. The combination of R / B – 1 / 1.7, where the proportion of blue light increases, is most effective for the accumulation of biomass of lettuce (by increasing the area and number of leaves). We also demonstrate that red / blue 1.3 / 1 and 2.3 / 1 combinations stimulate the production of vitamin C in a salad. Blue light promotes photosynthesis and growth, stimulating morphological and physiological reactions. Illumination with monochrome blue light shortens the internode, it can be used when growing seedlings in the greenhouse. The combination of R / B – 4/1 increases the content of soluble sugar and protein and improves the phenotypic characteristics, including plant height, stem diameter, and fresh weight.

The results showed that the ratio R / B – 4/1 can effectively improve the quality of lettuce, which will provide valuable information for optimizing the conditions for growing lettuce in production.

Since LED lighting with adjustable spectral composition can improve the productivity and nutritional characteristics of lettuce while reducing production costs in large-scale industrial production, it makes sense to use this technology more extensively in greenhouse lighting.

Keywords: *Lactuca sativa*, light-emitting diodes, spectral composition.



ASSESSMENT OF DROUGHT RESISTANCE AND ECONOMICALLY VALUABLE SIGNS OF YIELD OF COLLECTION OF COTTON VARIETIES

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Cotton is the raw material for the production of cotton fabrics. After treatment, cotton seed hairs are used in medicine called cotton wool. Cottonseed oil is obtained from cotton seeds. The leaves are used as raw materials for the production of citric and malic acids. The plant is a valuable honey plant.

The aim of the work was to identify for breeding cotton varieties, which combine drought resistance with positive indicators of economically valuable signs of yield.

The object of research was the collected samples of cotton (267 variety samples) of the Institute of Genetic Resources of the National Academy of Sciences of Azerbaijan. The study of the correlation between stress-resistance and economically valuable traits was performed using the SPSS 16.0 program. Cluster analysis of the degree of stability was determined using the UPGMA method of this program.

We have carried out an intra- and interspecific assessment of drought resistance of cotton accessions belonging to *G. hirsutum* L. and *G. barbadense* L. species and identification of the stress-resistant genotypes with the economically important traits were carried out for the first time.

Highly resistant samples were isolated inside the species *G. hirsutum* (AP-347, Karabakh-58, AP-16, AP-342 et al.) and *G. barbadense* (9732I, S-6035, 10964, Termez et al.) in which there is no stress-depression of seed germination during stress.

Analysis of the percentage ratio for drought resistance in various accessions of cotton revealed that *G. barbadense* species had higher resistance against the climate changing and acclimatization in new unusual conditions comparing with *G. hirsutum*. Thus, the number of cotton varieties that are highly resistant to drought for the species *G. hirsutum*, out of the total number studied, was 9.1 %, for the species *G. barbadense* – 28.6 %.

For drought-resistant cotton varieties, the main economically valuable signs of yield were studied. As a result of research, promising varieties of cotton have been identified for breeding (Aspero, 5010-V, 5230-V, AP-154, S-6002, 6465-V et al.) combining stress-resistance to drought with the main economically valuable traits.

The study of correlation between drought resistance and major economically valuable traits in *G. barbadense* accessions, led to the conclusion of a positive correlation between the drought resistance and flowering, seedlings and vegetation period, as well as a significant positive correlation between drought resistance and vegetation period, between flowering and vegetation period, number of cotton bolls and mass of raw cotton, and the mass of raw cotton and weight of boxes.

Thus, as a result of research, promising varieties of cotton have been identified for breeding combining stress-resistance to drought with the main economically valuable traits. These samples are recommended for cultivation in the appropriate soil and climatic conditions and can be used as donors in various breeding programs.

Keywords: Cotton, stress, drought, yield.



INFLUENCE OF FLAVONOIDS FROM *VERBASCUM PHLOMOIDES* L. ON THE HORMONAL STATUS OF PEARS

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One of the most important tasks of modern agriculture is to obtain environmentally friendly products that preserve the integrity of valuable substances. Recently, natural growth regulators have been increasingly used to control the production process of fruit crops; the exogenous use in minimal doses is able to mobilize the genetic potential of plant resistance to adverse environmental factors, positively affecting the yield and quality of the final product. Growth bio-regulators are obtained from various plants.

Potentially promising are plants with a high content of phenol compounds, which include the *Plantaginaceae* family, representative of the wild flora of Moldova, due to their significant physiological activity. The influence of the purified flavonoid extract, obtained from *Verbascum phlomoides* L. (medicinal mullein), which grows everywhere on the territory of Moldova and contains a significant amount of phenolic compounds, was studied on a variety of pears with different maturation periods.

As a result of the phytochemical analysis of the extracts of the above-ground part of the medicinal mullein, the presence of the main groups of biologically active substances was established: flavonoids, iridoids, polysaccharides, saponins, etc. To separate them, 40 % water-alcohol extracts were concentrated under vacuum, purified by chloroform from chlorophyll and lipophilic substances, and the aqueous fraction was separated on Sephadex LH-20, washing the column first with water, and then with ethanol with an increasing concentration of the latter from 40 to 95 %. All identical alcoholic eluates were combined, evaporated, dried and used to study its effect as a growth regulator on some indicators of growth processes and hormonal balance of the cultivars of pears growing in Moldova, 'Sokrovishce' and 'Noiabrskaia'.

Plants were sprayed with a 0.01 % flavonoid aqueous solution in the most important periods of vegetation (active growth of annual shoots, fruit growth, laying and differentiation of flower buds). Meanwhile, the biological activity of endogenous growth regulators, in leaves and fruits randomly collected, was determined by Kefeli and Thin Layer Chromatography method.

Studies have shown that plants are very responsive to the use of flavonoid extract from *V. phlomoides* and the effectiveness of its action is reliably established for both varieties. The mullein extract affects the hormonal status of the pear plant and stimulates the growth processes, leading to an incremental linear size of the plant organs and boosting the stimulating activity of endogenous growth regulators. The differences in the activity and the ratio of endogenous growth regulators in the control and the experiment itself, suggest that the effect of the flavonoid extract is due to its participation in the synthesis and decay of the endogenous growth regulators in leaves and fruits of the pear, which leads to a reconfiguration of the hormonal balance and contributes to a more complete realization of the reproductive and adaptive potential of plants.

Keywords: growth regulators, *Verbascum phlomoides* L., flavonoids, pear.



VARIATION IN FUSARIOSE RESISTANCE GENES OF *BETA VULGARIS* L. GENETIC RESOURCES

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Plant genetic resources are the major element of food safety of any country in the world. It concerns *Beta* L. genus in full measure. Sugar beet is a valuable industrial crop cultivated to produce the necessary foodstuff, namely, sugar. Its cultivation has started quite recently. Cultivated beets are descendants from the Mediterranean species *B. maritima*. For stable use of the crop introduced plants, it is necessary to conduct an estimation and selection for presence of phytopathogen, *Fusarium oxysporum* Schldl. in particular, resistance genes.

Aim of the investigations was to create specific DNA-markers, allowing identification of fusariose resistance genes. Plants of 6 sugar beet varieties served as a material for the investigations. Testing of plants for the presence of loci inherited linked to resistance fusariosis genes was carried out using 3 specific primer pairs: EBS0085 (F/R), BB02714 (F/R) and FusA (F/R).

To reveal the relation between SE2 and SP2 genes and sugar beet resistance to fusariose root rot, experiments using the above-mentioned molecular markers were performed. Amplification of plant DNA with the primer EBS0085 revealed the amplicon of 550 bp characteristic for the given marker in all samples. The homozygous (aa) 1, 5 and 6 genotypes (P1537, Russia; Poli, Bulgaria; Kirghizskaya 069, Kirghizia) in electrophoretogram (PCR amplification profile) had one distinct accurate and the most intensive amplicon whereas the 2, 3 and 4 resistant heterozygotes (ab) were presented by PCR-fragments with less expressed intensity and with an additional band of 700 bp. Amplification of plant DNA with the primer BB02714 revealed the amplicon of 484 bp in the length characteristic for the given marker in all samples. Amplification of plant DNA with the primer FusA also found out the amplicon of 650 bp characteristic for the given marker in all genotypes. Thus, during the investigations, sugar beet breeding samples presumably bearing genes of resistance to fusariose rot in their genome were selected. All 6 investigated samples of sugar beet plants (origin: Russia, Ukraine, Germany, Latvia, Bulgaria, Kirghizia) appeared to be carriers of R-genes or loci inherited linked to genes of resistance to phytopathogens. These plants can be recommended for use as a starting material in breeding for resistance to diseases. As used here, however, the question is the presence of the required alleles. To determine the level of their expression and phenotype display, real-time investigation of these genotypes using new DNA-markers (SNP) and genetical sequencing is necessary.

Thus, the results of the conducted PCR-analyses indicate the need for further extending of molecular-genetic investigations for selection of sugar beet forms with increased resistance to diseases for optimization of a breeding process as a whole.

Keywords: sugar beet, resistance, *Fusarium oxysporum*, PCR-analysis, primers.

FORGOTTEN OR PROMISING: THE POPULARITY OF ASPARAGUS IS ON THE INCREASE**Olena Nochvina, Nataliya Mizerna**Ukrainian Institute for Plant Variety Examination Kyiv, Ukraine;
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The modern variety of rare vegetable crops is very diverse in terms of taste, the content of biologically active nutrients, colour, and form of consumption. Among them are amaranth (*Amaranthus* L.), artichoke (*Cynara* L.), bamia (*Abelmoschus esculentus* (L.) Moench), sweet potato (*Ipomoea batatas* (L.) Lam.), vinya (*Vigna* Savi), lagenaria (*Lagenaria* Ser.), Jerusalem artichoke (*Helianthus tuberosus* L.), fennel (*Foeniculum* Mill.), edible chrysanthemum (*Chrysanthemum coronarium* L.), citronella (*Cymbopogon nardus* (L.) Rendle) and garden asparagus (*Asparagus officinalis* L.).

Asparagus officinalis is included to the group of Agricultural: Vegetables of the State Register of Plant Varieties Suitable for Distribution in Ukraine and, as of 2019, it is presented by three cultivars of the Dutch breeding: Baklim, Ginlim and Grolim. 'Ginlim' has been registered in Holland since 1983 and is the most widespread in the National Registers of Europe. The peculiarity of this variety is that it may be grown as both white and green asparagus. It is a 100 % male hybrid. Its harvesting can continue from mid-April to mid-June.

The review of the National Registries of Europe shows that Holland is the leader with 30 cultivars, France has 17 cultivars, Italy 14, Germany 14, Spain and Poland 2 cultivars. In total, there are more than 300 cultivars of asparagus in the world.

Asparagus is much more popular in Europe than in Ukraine. The area under this crop in the EU is about 63 thousand hectares; production quantity is 250 thousand tons per year. Despite this, asparagus lacks in Europe and its import grows by 12–15 % annually. The main countries importing asparagus to Europe are China, Peru, and the USA.

In Europe, cultivation of asparagus is concentrated mainly in Germany (about 23000 hectares), Spain (14000 hectares) and Italy (11000 hectares). As for the gross collection, Germany is the leading producer with production quantity more than 133000 tons (90 % of white asparagus and 10 % green), Spain produces more than 60000 tons and Italy about 50000 tons. Other European countries have somewhat lower indicators: France and the Netherlands produce about 20000 tons, Poland and Greece increased production and approached 10000 tons.

Asparagus is not popular with the Slovaks, as well as with the Ukrainians. The first reason is that this is not a traditional vegetable, and the second reason is financial: the price per kilogram exceeds 6 euros in the business network. According to expert estimates, Ukrainians today grow asparagus on about 70–80 hectares, while commercial projects account for 30–36 hectares; however, these are rather small indicators compared with the European and world scale.

The replenishment of the State Register of Plant Varieties, Suitable for Distribution in Ukraine with new high-yielding varieties of asparagus and the increase in the cultivation area could help to transfer this crop from the standpoint of 'forgotten' or 'promising' to another level, that is widespread, popular, accessible, national, and Ukrainian.

Keywords: *Asparagus officinalis* L., cultivars, demand, register.



'DUOLIFE DAY' AND 'DUOLIFE NIGHT' – SYNERGIC PLANTS COMPLEXES OF CHRONOBIOTICS

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Chronobiotics are special plant substances which are able to regulate different phases of biological rhythms in the body. Some chronobiotics regulate the active phase of biorhythms in the daytime, others – relaxing chronobiotics, which extend the phase of rest and recovery at night. The analysis of biologically active food supplements (BAFS) was carried out 'DuoLife Day' and 'DuoLife Night'. They are made of plant material, which is selected on the principle of synergy for the correction of metabolism.

The purpose of the study was to combine extracts from plants that have a unidirectional effect on metabolism in the body day and night.

'DuoLife Day' is a BAFS – a unique herbal complex, an extract of thirteen herbs that can maximally mobilize the body, optimize the functioning of the system organs, and provide an effective metabolism in the light period. Extract of noni fruit in its composition guarantees the support of biological rhythm through the content of more than 150 biologically active substances that help to synthesize of serotonin and melatonin. Acai fruits provide a complex of polyphenols, trace elements, vitamins, which intensively reduce the amount of free radicals, so fight with aging. Fruits of pomegranate, cranberry and hawthorn are excellent products for optimal functioning of the cardiovascular and reproductive systems. Aloe provides cleaning of the organism, reduces intoxication, enhances regeneration. Raspberry and alfalfa have a detoxifying effect on the liver and restore the tissues of the respiratory system. Black elderberry in this complex acts as a source of anthocyanins, and sea buckthorn as a source of beta-carotene that enhances the functioning of the immune system. Grapes, Ginseng and Wild Rose actively stimulate the immune system, improve memory, promote purification, regeneration, and rejuvenation of the body.

Herbal complex 'DuoLife Night' consists of 13 extracts of various plants, which are also selected on the principle of synergy. This supplement is aimed at maximal recovery of metabolism at night because it is recommended for consumption at night. White Mulberry and Artichoke reduce the level of glucose and cholesterol of blood. The Milk Thistle, nettles, alfalfa and beets promote regeneration of the liver, remove inflammation, dilute bile. The plum reduces the free radicals, stimulates regeneration. Acerola provides skin elasticity, refreshes and moisturizes its, smooths wrinkles. The Grape balances the work of the biological clock at night and day. Vilcacora and Aronia restore immunity, delay the development of tumors, and reduce the formation of blood clots. Extract of Melissa acts soothing for the nervous system. Regular consumption of 'DuoLife Day' and 'DuoLife Night' will provide optimal functioning of the body, even during daily excessive load and systemic recovery at night.

Keywords: chronobiotics, DuoLife Day, DuoLife Night.



STATE OF CARTHAMIN IN WATER AND STEAM EXTRACTS OF SAFFLOWER (*CARTHAMUS TINCTORIUS* L.) PETALS

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The chemical structure and high polarity of carthamin, a red dye from Safflower, was reliably proven by numerous investigations using thin-layer and HPLC chromatography, H-NMR, and C-NMR. At the same time, some reputable sources indicate a very low solubility of carthamin in water.

The aim of this study was to identify the truth in this matter, to find out the cause of the discrepancies, to establish the relationship between the form of these dyes in aqueous media and their applicability in various food products.

Safflower air-dry petals served as raw materials for carthamin obtaining. Microscopic examination showed that the dye is in the petals in the form of grains of 30 ± 5 microns in size. Hot steam with a temperature of 98–99 °C was passed through a loose layer of petals at a speed of 1 g/min. The condensate was collected in individual portions, then electron spectra were recorded in the range of 200–800 nm for each portion collected. The spectra are characterized by two peaks at 330 and at 395 nm. Despite the fact that the peak at 330 nm is higher, the peak at 395 nm is more suitable for the quantitative characterization of the content of dyes in steam extracts, since it is more distinct. It is important, that all UV-Vis spectra integrals of extracts obtained by hot steam are proportional to the values of the main optical densities at 395 nm. This correlation is a simple proof of the constancy of the composition of the various parts of the extract (in relation to substances active in the spectra) during extraction.

We have found that aqueous dye extracts contain unidentified biopolymers that behave like electrically charged oligosaccharides. The separation of the solid phase of these oligosaccharides takes place in a range of 3–7 pH-units. We managed to separate the white alcohol-insoluble precipitate of biopolymers from a high water- and alcohol-soluble dye. Thus, carthamin in aqueous extracts loses in solubility precisely due to the formation of complexes with biopolymers.

At the same time, in case of steam extraction, a completely water-soluble dye is obtained. To extract 30, 60, 95 and 99 % of the coloring matter, you need to skip about 12, 25, 40 and 50 g of hot steam through 1 g of petals, respectively. Low velocity of extraction can be explained with the natural state of carthamin in form of solid grains in Safflower petals, which extend the time of diffusion and elution of dye.

From our point of view, differences between the state of carthamin in petals, hot-water and steam extracts explain the discrepancies between the polar structure and the seemingly low solubility of carthamin in water. To verify this hypothesis, we initiated an electrochemical study, the results of which will be presented later.

The temperature resistance and confirmed high solubility of carthamin in water (in the condition of its separation from accompanying substances) makes this dye suitable to various technological operations and contribute to increasing the economic feasibility of Safflower growing. Carthamin is an excellent natural alternative to synthetic azo dyes, which, unfortunately, are still used in food products. Steam-extraction of Safflower petals provides sterilized water-soluble red natural dye with a wide range of uses.

Keywords: carthamin, solubility in water, steam extraction, bio-polymers, UV-spectra.



BUCKWHEAT AS AN IMPORTANT PART FOR ORGANIC AGRICULTURE AND AGRO-BIODIVERSITY

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Buckwheat as an agricultural crop, today does not occupy a significant place in agricultural production yet. But because of the unique grain composition by the content of proteins, vitamins, and minerals, which have significant antioxidant properties, buckwheat is often a crucial component of a healthy diet. It is also indispensable for organic farming – have a significant sensitivity to the ecological state of the environment. A significant role of buckwheat in creating an indispensable product of the therapeutic and prophylactic direction, which is buckwheat, honey. Buckwheat honey occupies the first place among products in this direction.

Despite the extensive experience in buckwheat growing in the world (over 2,000 years), today scientists are opening new directions for the use of buckwheat as an agricultural crop and food products made from it. The material for further research of buckwheat and its products may be samples of the National Collection of Ukraine. More than 1.6 thousand samples of the different ecological and geographical origin of 4 botanical species are concentrated there. To this aim annually 150–200 samples are sown and the study of planting material in the traditional directions – allocation of sources for the creation of new high productivity and adaptivity cultivars is carried out. On the station is study new directions of use buckwheat for the production of a honeycomb conveyor, the use of planting mass for green fertilizer, use new botanical species of buckwheat as a material to create valuable buckwheat products.

During the last 5 years at the Ustymivska Experimental Station of Plant production, a population variety Population 2017/1 was created for use as green fertilizers by the method of selection according to the level of development and growth rate of buckwheat plants. This variety, in comparison with the standard variety Ukrainka, forms 1.5–1.8 times more green mass (up to 85–100 tons/ha). With the use of such material as green fertilizers, it is possible to bring with a green mass in the soil to 170 kg/ha of nitrogen, 50 kg/ha of phosphorus, 250 kg/hectare of potassium. This is a good alternative as oppose to ecologically dangerous mineral fertilizers.

In countries of Europe and the world, the great importance in nutrition is the use of healthy and nutritious food. Common buckwheat (*Fagopyrum esculentum* Moench.) is used in Ukraine as a source of useful and essential proteins, vitamins and minerals. But the greater content of useful components contains another botanical species – Tartary buckwheat (*Fagopyrum tataricum* Gaertn.). In the research station, a number of studies were conducted on the comparative evaluation of different samples of this species of buckwheat different origin to detect the most productive of them, which are able to form a larger amount of grain and green mass for food processing.

The study of different buckwheat varieties according to the level of production of honey is carried out in terms of productivity of nectar per unit area, attractiveness for bees, and others like that. Among the great diversity, varieties are selected that are most suitable for the production of honey and recommended for the creation of a honeycomb conveyor for production of honey for a long time. They include varieties Zelenokvitkova 90, Ukrainka, Sofia, Elena (Ukraine), Lakneya and Smuglyanka (Belorussia), Bashkirskaya krasnostebel'naya and Agidel' (Russia) and other.

Keywords: buckwheat, green fertilizers, *Fagopyrum tataricum* Gaertn., honey.



ANTIOXIDANT ACTIVITY OF GRAINS OF OATS IN THE NON-CHERNOZEM ZONE OF THE CENTRAL REGION OF RUSSIAN FEDERATION

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Oat is known for its ability to adapt well and grow in different climates conditions. Currently, the world is increasing the demand for the most useful for human health food supply. Oats can meet these needs. Compared to a grain of wheat, in oat grain, as a rule, it contains more nutrients, which is attractive for manufacturers, and consumers. Oats are rich in a number of biologically active compounds, including beta-glucan, phenolic compounds and antioxidants. More and more domestic and foreign works indicate, that products derived from oats help reduce cholesterol and provide a cardioprotective effect on the human body.

In the Non-Chernozem zone of Russian Federation was evaluated samples of oats from the collection of VIR and selected 41 samples (20 naked and hulled 21) for several economically important traits (yield and disease resistance) of various ecological and geographical origin. At the allocated samples antioxidant activity of flour of water extracts was determined by the DPPH method using radical 2,2-diphenyl-1-picrylhydrazyl (Plank et al., 2012). Before grinding the film forms, the grains were removed floral scale.

In aqueous extracts, the content of antioxidants in grains of naked forms of oats ranged from 4.31 to 9.35 %, with an average of 6.61 ± 1.4 %, and from membranous – from 4.73 to 8 %, with an average of 5.86 ± 1.04 %. At the same time, the largest performance among the naked forms was observed in species *Avena sativa* var. *maculata* – 9.35 ± 1.47 %, *A. sativa* var. *chinensis* – 6.7 ± 1.10 %. Among the membranous forms of the separated samples with white and yellow color flowering glumes: *A. sativa* var. *krausei* – 7.08 ± 1.13 %; *A. sativa* var. *mutica* – 6.61 ± 1.07 %. The varieties of *A. sativa* var. *brunnea*, *A. sativa* var. *montana* with the brown color of the scales, after their removal, the content of antioxidants in the grains it was on average lower (4.83 ± 0.94 % and 5.43 ± 0.59 %, respectively).

Among the naked forms stood out the varieties with the highest antioxidant activity of aqueous extracts flour: Ba You 3 (K-15665) – 9.35 ± 1.47 %, Sibirskiy golozerny (K-15063) – 8.24 ± 0.49 %, Bai Yan 5 (K-15648) – 7.72 ± 0.46 % and Pin 16 (K-15653) – 7.70 ± 0.29 %, which exceeded the rest of the naked samples by 1.94–5.04 %.

Among membranous forms separated samples Z 615-4 (15349) – 8 ± 0.45 % and GN 08214 (15358) is of 7.17 ± 0.89 %, exceeding other samples by 1.0–3.27 %.

Thus, we have found that the content of antioxidants in oats is higher in the naked forms of oats, according to compared to the filmy ones. In turn, the capillary oats in aqueous extracts of the antioxidant content in the caryopsis were higher in forms with the white and yellow color of flower scales, compared with brown.

Keywords: naked oats, hulled oats, antioxidant activity, grains.



AMINO ACID COMPOSITION OF LEAVES, FRUITS, SEEDS AND CALYX OF AMERICAN PERSIMMON (*DIOSPYROS VIRGINIANA* L.)

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Diospyros virginiana L. (American persimmon) since ancient times are used in folk medicine. The fruit has been used medicinally as antiseptic and for the treatment of burns, diphtheria, dropsy, diarrhea, gonorrhoea, candidiasis, dysentery, fevers, thrush, fungal and bacterial infections, gastrointestinal bleeding, sore throats, exhibit antimicrobial and antifungal activities. Also, the persimmon fruit can be considered as a highly nutritional product because of its strong antioxidant capacity induced by a high content of flavonoids, vitamin C, beta-carotene. Biologically active compounds are located not only in fruits but in different parts of the plant: bark, wood, leaves, roots. The bark has antiseptic properties, hepatoprotective and antipyretic activity, the leaves showed antimycobacterial effect, the roots of American persimmon showed antifungal effect. Powder of dry leaves has been used for a long time in folk medicine. The leaves of *Diospyros virginiana* found lupeol, betulin, betulinic acids – components that are famous with their antitumor properties.

The aim of this study was to investigate qualitative and quantitative content of amino acids compounds of leaves, fruits, seeds and calyx of *Diospyros virginiana* from which are growing in Forest-Steppe of Ukraine in M.M. Gryshko National Botanical Garden of NAS of Ukraine (NBG). The content and composition of amino acids determined on automatic amino acid analyzer AAA 339 M (MIKROTECHNA, Czech Republic).

As a result of the research, it has been found that the fruits amino acids (alanine, asparagine, cysteine, glycine, glutamine, proline, serine, tyrosine) in an amount from 0.1 to 1.4 g/kg⁻¹. Seeds contained from 0.6 to 5.6 g/kg⁻¹, leaves from 2.2 to 17.4 g/kg⁻¹ and calyx from 2.9 to 12.6 g/kg⁻¹. Also, the content of essential amino acids arginine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, valine was distributed as it follows: in fruits from 0.2 to 2.1 g/kg⁻¹, in seeds from 0.01 to 3.5 g/kg⁻¹, in leaves from 2.3 to 12.3 g/kg⁻¹, in calyx from 1.3 to 23.5 g/kg⁻¹. The result of the research allows us to state that the highest level of amino acids can be found in leaves and calyxes. Among the essential amino acids (g/kg⁻¹), the highest content in leaves was 12.3 (arginine), 10.1 (leucine), 8.1 (valine), among non-essential amino acids 17.4 (glutamine), 10 (asparagine), 6.8 (alanine). In the calyxes, the highest content was 23.5 (histidine), 12.6 (glutamine), 11.3 (asparagine), 9.6 (leucine), 8.4 (valine), 7.3 (alanine).

Obtained results of this study indicated about high and diversified content of amino acids and allow to suggest the availability of wide specter of pharmacological activity of leaves, fruits, seeds, and calyx *Diospyros virginiana*. This indicates on the perspective of the use of investigated raw (particularly, leaves и calyx) as a source of essential and non-essential amino acids, and also can be used for in-depth study of *Diospyros virginiana* as a source of other biologically active compounds.

Keywords: *Diospyros virginiana*, amino acids, leaves, fruits, seeds, calyx.

Acknowledgments

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INFLUENCE OF ALGAE ON THE CHANGE OF BUTTER QUALITY INDICATORS

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One of the important directions of the food industry development is the use of natural antioxidants in the technology of dairy products production to increase their storage life. Butter is a product containing a large amount of fat, which is subjected to hydrolytic and oxidative damage in the process of storage. Addition of natural antioxidants in butter contributes to maintaining high consumer performance of the product by blocking the accumulation of free radicals and free fatty acids. Numerous studies have shown, that the addition of herbal supplements improves the organoleptic characteristics of the product, has a positive effect on the formation of its structure and consistency, gives the product a high ductility index, thermal stability, and spreadability, and slows oxidation processes during storage. The aim is to investigate the influence of algae on the change of indicators of quality of butter during storage.

One had chosen the samples of butter with the powder from laminaria, fucus, spirulina, and cystoseira as the object of the study; the butter with mass fraction of fat 62.5 % had been chosen for control. Samples have been stored at the temperatures of 3 ± 2 °C (above) and 7 ± 2 °C (below) for appropriate determining of the ongoing changes in samples' organoleptic properties (taste and smell) as well as the primary oxidation of products – Peroxide and hydrolysis of lipids at different stages.

The use of algae for butter production allows extending product storage life twice. Therefore, the dynamics of organoleptic characteristics of butter containing algae showed a quality improvement for control samples during storage at a temperature of $+3\pm 2$ °C at the 45th day by 4 points, those containing algae by 2 points; when stored under conditions of -7 ± 2 °C at the 65th day indicators decreased by 5 points in the control sample, and by 2 points if to talk about those containing algae. When storing the samples under conditions of the temperature of $+3\pm 2$ °C, the change of the set of indicators takes place more intensively in comparison with storage conditions at a temperature of -7 ± 2 °C, which is explained by the influence of low temperatures. Peroxide value of fat in the control sample of the butter after 30 days was 4.9; peroxide value of the butter containing algae was from 3.2 to $3.5\frac{1}{2}$ 0 mmol/kg, respectively. Similar dependence is set in the study of the hydrolysis of fat, as all kinds of algae slow the processes of accumulation of free fatty acids twice. We may presume, that the effect observed is caused by the presence of selenium, pigments, bioflavonoids in algae, and the formation of polysaccharide-lipid complexes on the surface of nanograins, which protect the fat phase from oxidation and hydrolysis.

Thus, addition of algae to butter slows the deterioration of the organoleptic characteristics, as well as the processes of oxidation and hydrolysis of fat during storage both at low and high temperatures.

Keywords: butter, laminaria, fucus, spirulina, cystoseira, storage.



ESSENTIAL OILS OF LAVANDINS AND THEIR ANTI-CANDIDA ACTIVITY

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Candida spp. are the most common etiological agents of candidiasis, causing not only superficial mucosal candidiasis but also life-threatening systemic infection especially in immunocompromised patients. The presence of clinical strains of *Candida*, resistant to currently used chemically synthesized antifungal agents, causes the urgent need for the development of new antifungal drugs based on substances of natural origin. Lavandins Inii and Rabat are interspecies hybrids obtained as the results of natural and artificial selection of *Lavandula angustifolia* Mill. and *Lavandula latifolia* Medic. (Svydenko, 2001). Phytochemical screening of Inii and Rabat active components revealed a high content of essential oils (EOs).

The aim of this study is to show the anticandidal activity of Inii and Rabat lavandins EOs against the clinically important yeasts: *Candida pseudotropicalis*, *C. parapsilosis*, *C. curvata*, *C. kefir*, and *C. tenuis*. EOs of collected lavandins' Inii and Rabat inflorescences were extracted by hydrodistillation in a Clevenger apparatus. The strains used from the Microbial Culture Collection of the Department of Microbiology of Ivan Franko National University of Lviv. The standard agar well diffusion method was used to determine the sensitivity of microorganisms to EOs. The samples of lavandins' Inii and Rabat EOs in the amount of 100 µL or 200 µL were applied. Decasanum and Essential Oil of Lavender (*Lavandula angustifolia* Mill. of the genus *Lavandula* (family Lamiaceae) were used as controls.

Results indicate that all *Candida* strains used during the present study are completely sensitive to essential oils of lavandins Inii and Rabat. Both the tested oils demonstrated inhibitory action against all the *Candida* species at low concentration. The most sensitive were *C. pseudotropicalis*, *C. parapsilosis*, and *C. kefir*, some less sensitive were *C. curvata* and *C. tenuis*. The anticandidal activity of the essential oils of both investigated lavandins may be related to their major volatile compounds, namely linalool, linalyl acetate, 1.8-cineole, and camphor. It is more likely that the anticandidal effect is provided by the joint action of all the components present in the composition of the essential oils. It was found that the anti-candidal activity of EOs of lavandins Inii and Rabat is comparable to that of EOs of lavender (*Lavandula angustifolia*) and significantly exceeds the efficiency of Decasanum.

Essential oils of lavandins Inii and Rabat are a promising use in healthcare decontamination against *Candida* spp. The ability to obtain a sufficient amount of plant material of lavandins in Kherson region indicates a good prospect of further research and the use of their essential oils on an industrial scale.

Keywords: lavandin, essential oil, anti-candida.

**THERAPEUTICAL EFFECT OF *CORNUS MAS* L. FRUITS IN HUMAN MEDICAL PRACTICE****Jan Lietava**

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Cornelian cherry (*Cornus mas* L.) (CC) is used as a food item as well as traditional medicine from south Europe, to Subhimalanian region since Laten period (cca 450 BD to 100 AD). CC fruits contain a wide range of phytochemicals, including tannins (131.51–601.2 mg/L), phenolics (29.76–74.83 mg/g dry), organic acids (4.6–7.4 %), anthocyanins, fatty acids, and flavonoids (Klimenko et al., 2004). The anthocyanins present in CC are delphinidin 3-O-beta-galactopyranoside, cyanidin 3-O-beta-galactopyranoside, and pelargonidin 3-O-beta-galactopyranoside (Seeram et al., 2002). Fruits are reported to contain 0.1–0.3 % fat, 0.4 % protein, 21.7 % carbohydrates, 0.8 % ash, 0.5 % dietary fibers, 6.6–15.1 % total sugars (fructose 33.1–43.1 %, glucose 53.6–63.1 %), and 4.22–9.96 % reducing sugars as well as 15 amino acids (Brindza et al., 2008). CC juice contains high level of calcium (323 mg/l) exceeding 10 fold content in plum, pear or apple juice and comparable amount of potassium, sodium, zinc, and manganese. Typical is high level of polyphenolic compound – gallic acid (45.5 mg/g) with highly expressed antioxidant activity evaluated as a ferric-reducing antioxidant power, which was 10-fold higher in comparison with mentioned fruits.

CC exhibited strong antioxidant-related effect in experimental conditions both in vitro and in vivo. Several animal studies have shown important effect of CC on classical risk factors of atherosclerosis. Sozanski et al. (2014) studied effect of CC fruit lyophilisate on PPARalpha protein expression and atheromatous changes in hypercholesterolemic rabbits. CC in dose of 100 mg/kg b.w. caused 44 % decrease in triglycerides (TG) and prevented development of atheromatous changes in aorta. Hepatic PPARalpha protein expression was significantly increased. The effect of CC on hepatic function is supported also by observation of increased total antioxidant capacity of the liver, however, without changes in activity of superoxide dismutase, catalase, glutathione peroxidase, and hepatic lipid peroxidation.

Favorable results were found by Asgary et al. (2014) in rats with alloxan induces diabetes, who besides of hypolipidemic effects, reported also antihyperglycemic effect of CC comparable with glibenclamid therapy in control group. Rassoulian et al. (2012) confirmed hypoglycemic effect of CC in hamsters fed by CC fruits with subsequent elevation of insulin level. The neuroprotective effect was found in Wistar rats treated by freeze-drying lyophilisate CC powder and exposed to high-fat or fructose diets. CC causes decrease of the plasmatic catalase activity and increased in brain suggesting increased cerebral protection. The similar favourable effect was found in response of paraoxonase 1, which inhibits oxidation of lipoproteins and of carbonyl groups and which are markers of protein damage.

In the only PubMed published controlled clinical study, Asgary et al. (2013) studied the hypolipidemic and antiinflammatory effect of 100 grams of CC added to diet for 6 weeks in 40 dyslipidemic children and adolescents aged 9–16 years. The intervention group demonstrated significant decrease in total cholesterol, TG, LDL cholesterol, apoB, ICAM-1 and VCAM-1 levels.

A clear improvement of lipid spectrum and inflammation markers after a mild intake of Cornelian cherry added to usual diet predispose the fruits as supportive therapy of main risk factors of atherosclerosis.

Keywords: *Cornus mas*, atherosclerosis, oxidative stress, lipid spectrum, risk factors.

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