МІНІСТЕРСТВО ОХОРОНИ ЗДОРОВ'Я УКРАЇНИ

МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ

КАФЕДРА ФАРМАКОГНОЗІЇ ТА БОТАНІКИ

НАУКА, ПРАКТИКА ТА ОСВІТА

PLANTA+

ТОМ 1

20 лютого 2023 р.
м. Київ, Україна

МІНІСТЕРСТВО ОХОРОНИ ЗДОРОВ'Я УКРАЇНИ
МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
НАЦІОНАЛЬНИЙ МЕДИЧНИЙ УНІВЕРСИТЕТ ІМЕНІ О.О. БОГОМОЛЬЦЯ
НАЦІОНАЛЬНИЙ ФАРМАЦЕВТИЧНИЙ УНІВЕРСИТЕТ
ПРИВАТНИЙ ВИЩИЙ НАВЧАЛЬНИЙ ЗАКЛАД
"КИЇВСЬКИЙ МЕДИЧНИЙ УНІВЕРСИТЕТ"
ІНСТИТУТ БОТАНІКИ ІМ. М.Г. ХОЛОДНОГО НАН УКРАЇНИ

«PLANTA+. НАУКА, ПРАКТИКА ТА ОСВІТА»

Матеріали
IV Науково-практичної конференції з міжнародною участю,
до 20-річчя кафедри фармакогнозії та ботаніки
Національного медичного університету імені О.О. Богомольця

Том 1

20 лютого 2023 року
м. Київ

USE OF EXTRACT OF *ACTINIDIA ARGUTA* LEAVES FOR THE SYNTHESIS OF NANOMATERIALS WITH PHOTOCATALYTIC AND ANTIMICROBIAL PROPERTIES

Kovalska N.[1], Sydorchuk V.[2], Karpiuk U.[1]

[1]Bogomolets National Medical University, Kyiv, Ukraine

[2]Institute for Sorption and Problem of Endoecology, National Academy of Science, Kyiv, Ukraine,

tsveyuk@gmail.com, bilychi@ukr.net

Key words: *Actinidia arguta* leaves extract, nanomaterials, antimicrobial properties, photocatalysis, pollutant degradation.

Introduction. Nanotechnology in the development of effective antimicrobial agents is a promising direction of scientific research in the whole world, since the resistance of bacteria to antibiotics has become a global problem in the treatment of infectious diseases. The antimicrobial activity of silver nanoparticles has been studied the most. There are chemical, physical and biological methods of synthesizing metal nanoparticles. The green synthesis method is advantageous due to its simplicity, low cost and environmental friendliness. In the method of green synthesis of nanoparticles of silver and other metals, plant extracts are used. Secondary plant metabolites, such as polyphenols, proteins, phenolic acids, flavonoids, terpenoids, etc., play a decisive role in the recovery of metal ions [1]. This approach of plant extracts is in the trend of recent decades, aimed at replacing mineral raw materials with renewable ones and protecting the environment. Nanomaterials obtained on their basis have environmental, pharmaceutical and biomedical applications. There are two goals for green synthesis of nanomaterials: 1) Creating eco-friendly technologies; 2) Their use in process of water and air purification, particularly photocatalytic degradation of pollutants. As a result, harm to human health and the environment as a result of human activity can be minimized. The existing techniques for synthesis of nanomaterials are multi-stage and also involve expensive and toxic reagents, solvents and result in the formation of secondary pollution [2]. The use of plant raw materials, primarily plant extracts, largely solves these problems. The main difference in plant extract mediated synthesis route lies in the replacement of inorganic chemical reducing agents (such as hydrazine, sodium borohydride) with biomolecules of plant extract [3]. The aims of this work are the study of *Actinidia arguta* leaves extract use for synthesis of photocatalysts based on zinc oxides and their testing in dyes degradation in wastewater.

Materials and methods. As the raw material were harvested and dried leaves of *Actinidia arguta* Lindl. `Kyivska krupnoplidna` in August 2021 at collection of M. M. Gryshko National Botanical Garden of National Academy of Sciences of Ukraine (Kyiv). *Actinidia arguta* leaves extract (AALE) was obtained by three times hot extracting actinidia leaves with 40% ethanol in a ratio of 1:10. The obtained extract was filtered and evaporated on a Heidolph Hei-VAP Core rotary vacuum evaporator to obtain a dry extract.

Zinc oxide powder (Sigma) as initial material was chosen because it is an eco-friendly and safe for daily application semiconductor with good biocompatibility. However, ZnO has band gap E_g within 3.0-3.5 eV which makes it impossible to use under visible irradiation and wide practical utilization. To overcome this drawback, zinc oxide was modified with actinidia extract. Another option is the formation of silver nanoparticles on the surface of zinc oxide using the extract as a soft reducing agent. In both cases, ball milling was used as technological procedure for preparation of modified nanomaterials. Obtained samples were tested as photocatalysts in process of safranin T (ST) degradation under visible light.

Results and their discussion. The characteristics of some prepared materials are presented in Table 1.

Table 1

Adsorption and photocatalytic properties of some materials respect to safranin T

Samples	Eg, eV	Adsorption, %	Photocatalysis, %	K_d 10^5, s^{-1}
ZnO initial	3.31	30	Non-active	Non-active
Milling with AALE	3.17	82	15	0.25
Milling with AALE and $AgNO_3$	3.07	70	27	0.37
Milling with leaves	3.19	80	10	0.20
Milling with leaves and $AgNO_3$	3.11	75	18	0.32

The following trends in changes of physicochemical characteristics, which determine the adsorption and photocatalytic indicators of zinc oxide, were established. Firstly, modification of the oxide surface with organic compounds that are part of AALE occurs during milling. As a result, several times increase in ST adsorption is observed. This is due to affinity between benzene rings of dye and compounds of modified layer of photocatalyst. Secondly, the narrowing the band gap to 3.07-3.19 eV takes place. This causes to acquire photocatalytic activity of ZnO under visible irradiation. Thirdly, the presence of band within 400-500 nm in UV-Vis spectra indicates silver is in metallic state at surface – as nanodots. These Ag-containing samples have maximum photocatalytic activity and may be promising as antibacterial materials.

Conclusions. Therefore, the use of AALE in the synthesis of photocatalysts based on ZnO greatly simplifies the procedure and allows obtaining samples that have an increased adsorption capacity in relation to the dye and are also photocatalytically active in the visible region. The total degree of ST removal from the solution due to adsorption and photocatalysis reaches 90-97%.

References:

1. Salayová, A.; Bedlovicová, Z.; Daneu, N.; Baláž, M.; Lukácová Bujnáková, Z.; Balážová, L'.; Tkáciková, L'. Green Synthesis of Silver Nanoparticles with Antibacterial Activity Using Various Medicinal Plant Extracts: Morphology and Antibacterial Efficacy. Nanomaterials 2021, 11, 1005. https://doi.org/10.3390/nano11041005

2. Joseph, A., & Vijayanandan, A. (2021). Photocatalysts synthesized via plant mediated extracts for degradation of organic compounds: A review of formation mechanisms and application in wastewater treatment. Sustainable Chemistry and Pharmacy, 22, 100453. doi:10.1016/j.scp.2021.100453

3. Jadoun, S., Arif, R., Jangid, N. K., & Meena, R. K. (2020). Green synthesis of nanoparticles using plant extracts: a review. Environmental Chemistry Letters. doi:10.1007/s10311-020-01074-x

FEIJOA SELLOWIANA O.BERG: CONSUMER AND MEDICINAL PROPERTIES

Krasovskyi V.V.[1], Cherniak T.V.[1], Fed'ko R.M.[2]

[1]Khorol Botanical Garden, Khorol, Ukraine

[2] The research station of the medicinal plants of the Institute of Agroecology and Nature Management of the National Academy of Sciences, p. Berezotocha, Lubensky district, Poltava region, Ukraine

horolbotsad@gmail.com; ukrvilar@ukr.net

Key words: botanical garden, *Feijoa sellowiana*, valuable properties

Due to the climate change towards the warming, there is an opportunity to the significantly intensify the introduction of the new subtropical fruit plants with useful properties from the south to the north, in particular in the Forest Steppe of Ukraine. *Ex-situ* conditions facilitate the implementation of this process in practice. Thus, among the collection samples of the subtropical fruit crops of the Khorolskyi Botanical Garden, *Feijoa sellowiana* O.Berg from the *Myrtaceae* family is a promising species for further *ex-situ* study and the adaptability in a changed agro-climatic environment. The introduction potential of *F. sellowiana* is based on the fact that the species can grow in the areas where there is a short-term decrease in temperature to minus 15 ºC [6, 8].

By the developing and carrying out the effective measures to protect *F. sellowiana* from the effects of the low winter temperatures, cultivars can acquire the ability to grow in the open ground and bear fruit. The experience gained in the process of the experimental introduction and the acclimatization works in the Khorolsk Botanical Garden with the subtropical fruit crops provides the opportunity to select the best local genotypes. Over time, in the process of selection work, there is a prospect of spreading the species among the amateur gardeners in the region.

In the conditions of the natural distribution and the traditional cultivation, the plant is valued for the special taste qualities of the fruits. They have medicinal and dietary properties, and the characteristic harmonious combination of the content of acids, sugars and pectin substances, it is important during the preparation of various high-quality food products. The characteristic feature of *F. sellowiana* is the high content of phytoncides, significant resistance to diseases and pests. It is widely used as a decorative culture in all types of landscaping, due to the peculiarities of its flowering.