CEI2021



BOOK OF ABSTRACTS

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CEI2021

Conference plan – DAY 1 (September, 22nd)

Time	Speaker	Title
9:00	Joanna Karpińska Piotr Zieliński	Welcoming to the participants
Section 1. Good practice in monitoring of environment pollution		
Plenary lecture		
9:20	Andrzej Górniak	*Will be provided soon*
10:00	Cecylia Wardak	Nitrate ion-selectve electrodes-new constructions and aplications in the monitoring of nitrate ions in environmental samples
Oral presentations		
10:40	Urszula Kotowska	Mass loading and environmental risk of contaminats of emerging concern discharged into surface water from Polish municipal WWTPs
11:10	Justyna Kapelewska	The role of microplastics in the transport of pollutants and their impact on living organisms
11:25	Jakub Maculewicz	Bioconcentration assessment of ionic and ionogenic compounds
11:40	Małgorzata Grabarczyk	Influence of the type of working electrode on the limit of detection in voltammetric procedures for the determination of In(III) in environmental water samples
11:55	Agnieszka Szymaszek	Catalytic activity in selective catalytic reduction of nitrogen oxides with ammonia (NH_3-SCR) of natural clinoptilolite modified with iron by various methods
12:10	Klaudia Świacka	Uptake, bioconcentration and mass balance of diclofenac and 4-OH diclofenac for the evaluation of their environmental fate
Posters		
13:00	Urszula Klekotka	Stability of magnetite nanoparticles in environmental solutions
13:05	Marzena Adamczyk	Elimination of intereferents present in aqueous environmental samples involtammetric determination of trace concentrations of molybdenum ions
13:10	Kinga Ślósarczyk	DEET as an emerging contaminant in water
13:15	Katarzyna Szymczyk	Influence of the surfactant addition on the adsorption and volumetric properties of Acid Pure Green V
13:20	Karolina Pietrzak	The use of copper oxide nanoparticles for the construction of ion-selective electrodes with solid contact for the determination of copper ions in water
13:25	Mateusz Worobiczuk	"Microplastic is not fantastic" – about impact of photochemical changes on structure of microplastics

Conference plan – DAY 1 (September, 22nd)

Time	Speaker	Title
Section 2. Sustainable use and protection of flora and fauna		
Plenary lecture		
9:00	Oleg Sozinov	Rare and typical plant communities of the Svityazyansky Reserve (Belarus)
Oral presentations		
9:30	Marek Nieoczym	Genetic and morphological variability of the American mink *Neovison vison* feral population at the edge of its invasion range
9:45	Linas Balčiauskas	Do orchards maintain favorable states of small mammal communities?
10:00	Irina Abramova	Changes in bird communities throughout secondary bilberry pine forest succession in south-western Belarus
10:15	Linas Balčiauskas	Roadkills as a method to monitor raccoon dog populations
10:30	Halina Bohdan	Ura Grodno: Together we can do more!
Posters		
11:30	Joanna Kozłowska	Long term changes of crustacean zooplankton communities in lake Wigry as a response to changing trophic conditions – 100 years observations
11:35	Piotr Zieliński	Impact of water quality on summer bacterioplankton in springs of Gryżyński Landscape Park
11:40	Wojciech Pol	The litter per litre - Spatial and temporal changes in the microplastic pollution in two lowland rivers of NE Poland
11:45	Agnieszka Bona	Low reproduction efficiency may threaten *Betula humilis* growing in north-eastern European wetlands
11:50	Maria Janicka	Size and status of the population of *Dactylorhiza majalis* in the Rządza river valley depending on the frequency of mowing the meadows
11:55	Raisa A. Sukhodolskaya	Biotope impact on Fluctuating asymmetry manifestation in Ground beetles (*Coleoptera, Carabidae*)
12:00	Alyona Amshey	Biotesting of plastyfing additives used for production of polystyrene concrete

Conference plan – DAY 2 (September, 23rd)

Time	Speaker	Title
Section 3. Ecological biochemistry, physiology and medicine		
Plenary lecture		
9:00		*The Organising Committee will provide information as soon as possible*
Oral presentations		
9:30	Urszula Czyżewska	Report from the battlefield: the model of *Malassezia pachydermatis* resistance to polyenes
9:45	Anna Winiewicz	Profiles of antibiotic resistance among members of *Bacillus cereus sensu lato* isolated from syntanthropic birds
10:00	Marek Bartoszewicz	Into the deep blue – antibiotic resistance of *Bacillus cereus* sensu lato from sea water
10:15	Sandra Chmielewska	Response to long-term exposure to polyenes in *Candida albicans* strains
10:30	Ilya B. Zavodnik	Plant flavonoids: antioxidative properties, biochemical activity and hepatoprotective potential
10:45	Marcin Zając	The effect of polystyrene nanoparticles on *Staphylococcus aureus* bacteria
11:00	Dorota Kowalska	Blood proteins as an important reservoir of charged compounds in bioconcentration phenomena
11:15	Natalia Z. Bashun	In relation to the evaluation of human reserve capacity of the human body
Posters		
12:15	Violetta K. Macioszek	Phenotyping of spring oilseed rape cultivars (*Brassica napus*) against *Alternaria brassicicola*-induced disease
12:20	Bożena Kozłowska-Szerenos	The antioxidant systems in *Chlorella vulgaris* cells during phosphate deficiency
12:25	Jan Żeruń	Rhizobia as an ecological substitute for fertilizers
12:30	Weronika Zawadzka	Plant growth promoting traits in metal contaminated environment
12:35	Aneta Adamczuk	Water stress affect morphogenesis of flax (*Linum usitatissimum* L.) in *in vitro* cultures
12:40	Hazem M. Kalaji	Chlorophyll fluorescence signals as a future tool to provide plants with autonomous control over their growth environment
12:45	Magdalena Dobosz	Nanoparticles in food industry

12:50	Dorota Ławreszuk	Fecal glucocorticoids as indicators of stress in Capercaillie (*Tetrao urogallus*)

Conference plan – DAY 2 (September, 23rd)

Time	Speaker	Title
Section 4. Rational use of natural environmental resources and environmental protection		
Plenary lecture		
9:00	Halina G. Yukhnevich	Activated sludge microbial community of industrial wastewater treatment plants
Oral presentations		
9:30	Dariusz Kiejza	Application of d-electron metal ions/peracetic acid in UV stabilizers degradation
9:45	Weronika Polińska	The use of floating plant to remove benzotriazoles from water and wastewater
10:00	Dominika Fila	Application of low-cost alginate-based biosorbents for the effective rare earth elements recovery
10:15	Magdalena Saramok	Iron-modified clinoptilolite as a catalyst for the SCR process in nitric acid plants
10:30	Barbara Leśniewska	The study of the migration of toxic and potentially toxic elements from toys
Posters		
11:30	Irina Kolesnik	Spring water quality in Grodno: to drink or not to drink
11:35	Ewelina Polska-Adach	The use of phenol-formaldehyde sorbent in the process of acid and reactive dyes removal from aqueous solutions
11:40	Anna Wołowicz	Removal of vanadium(V) by adsorption onto ion exchangers from aqueous solutions
11:45	Monika Wawrzkiewicz	Kinetic studies on acid, direct and reactive dyes removal from aqueous solutions using strongly basic anion exchanger
11:50	Katarzyna Araucz	Citric acid as a natural complexing agent in the rare earth elements recovery process
11:55	Tatsiana Marchyk	Environmental assessment in the area of impact of the hosiery factory through the study of snow cover
The end of the conference		

Section 1

Good practice in monitoring of environment pollution

Nitrate ion-selectve electrodes-new constructions and aplications in the monitoring of nitrate ions in environmental samples

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Ion-selective electrodes due to many advantages, such as simplicity of use, low cost and high speed of measurements, as well as very good analytical parameters (low detection limits and high selectivity) have been widely used in recent years to determine various types of ions in environmental samples. Nitrates are ubiquitous in the environment, both in the air, soil and water, and are essential for the proper growth of plants and animals. Research is still ongoing to unambiguously determine the influence of consumption of increased doses of nitrates on human health. Therefore, it is important to develop appropriate methods for determining their content in natural samples and in food products. The paper reviews articles on the latest knowledge on the influence of nitrates on human health as well as on the development and application of potentiometric sensors for determination the content of nitrates in environmental samples including food products and various types of natural waters.

Mass loading and environmental risk of contaminats of emerging concern discharged into surface water from Polish municipal WWTPs

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Contaminants of emerging concern (CEC) are compounds detected in natural waters, that may cause environmental or human health impacts, and typically are not regulated under current environmental laws. CEC includes hundreds of organic compounds from diverse classes detected in waters usually in concentrations between ng/L and µg/L [1]. Although EOCs are usually unstable they can pose high risk because of their continuous release into environment together with wastewater, which are their main source. This work is a presentation of comprehensive investigation of the occurrence, mass loading and environmental risk assessment of CECs in wastewater from fourteen municipal wastewater treatment plants (WWTPs). It has been found that the efficiency of CECs removal during treatment in WWTPs depends on the properties of given compound as well as the size of the plant. Mean daily mass loads of individual pollutants discharged into the environment along with treated sewage reach several grams per day per 1000 inhabitants. Risk quotients for CECs present in effluents from WWTPs were calculated. Data analysis show that algae and cyanobacteria are organisms to which presence of CECs causes the highest environmental risk and fish are most resistant to these compounds.

This work was financed by National Science Centre Poland grant no 2019/33/B/NZ8/00012.

Literature:

[1] Kuzmanovic, M., Ginebreda, A., Petrovic, M., Barcelo, D., Sci. Total Environ. 503-504 (2015) 289-299.

The role of microplastics in the transport of pollutants and their impact on living organisms

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Since the 1950s the world's plastic production has increased above 240-fold (from 1.5 to 368 million tons in 2019). In 2019 Asia reached 51% of the world's plastics productions, while the NAFTA countries produced 19%. After 2005 plastic production by countries of the European Union, as well as Switzerland and Norway, has more or less stabilized at around 60 million tons per year, or 16% of global production in 2019 [1]. Mass production of plastics contributes to the enormous accumulation of polymer waste in the environment. Plastic particles are classified according to their particle size as macroplastics (>25 mm), mesoplastics (25–5 mm), microplastics (5 mm–1 μm), or nanoplastics (<1 μm) [2]. The surface of microplastics (MPs) under environmental conditions is rough, therefore more and more attention is paid to their adsorptive properties and their role in the transport of organic and inorganic pollutants. This phenomenon is called the "Trojan Horse" effect [3]. Polymer particles, along with any contaminants can be transported great distances from pollutant discharge sites by wind, river, or sea currents. Microplastics present in the environment have an impact on living organisms. The presence of MPs causes oxidative stress and neurotoxicity which affects the growth, reproduction, and survival of living organisms [4].

Literature:
[1] Plastics Europe. Plastics - the Facts 2020.
[2] DKA. Barnes, F. Galgani, RC. Thompson, M.Barlaz. *Phil. Trans. R. Soc. B*. 364 (2009) 1985–98.
[3] A. Menéndez-Pedriza, JI. Jaumot. *Toxics*. 8 (2020) 40.
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Bioconcentration assessment of ionic and ionogenic compounds

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Bioconcentration of pollutants in the tissues of aquatic organisms is a phenomenon that can have many negative ecological implications. So far, however, it is not clear how much of a threat ionic and ionogenic compounds pose in this context. Studies in recent years confirm the large presence of ionogenic compounds, such as pharmaceuticals and their transformation products (TPs), in the aquatic environment. Another group of concern are ionic liquids, the increased production and use of which may lead to their appearance in the environment. However, very little is known about the fate of these chemicals, especially in the context of effects on organisms through toxicity or bioconcentration. Therefore, the aim of this study was to assess the potential for bioconcentration of selected cations of ionic liquids and TPs of pharmaceuticals using artificial cell membranes. In the present study it has been observed that organic cations of ionic liquids may show significant affinity to biological membranes, and the main factor influencing the potential for bioconcentration is their hydrophobicity. Conversely, we observed that tested TPs of pharmaceuticals show rather small affinity to lipids, much lower than in case of parent compounds. However, the confirmation of the results with *in vivo* measurements will allow for a better estimation of the potential for bioconcentration of ionic and ionogenic compounds.

The authors would like to acknowledge the financial support of the National Science Centre (Poland) under decision NCN2016/23/G/ST5/04245.

Influence of the type of working electrode on the limit of detection in voltammetric procedures for the determination of In(III) in environmental water samples

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Three simple and fast adsorptive stripping voltammetric procedures for trace determination of indium in environmental water samples were described. For all indium ion determination procedures, cupferron was used for the first time as a complexing agent. However, these procedures differed in the key element which is the working electrode, which largely determines the detection limit and the range of quantification. The following working electrodes were used in the research: a mercury film electrode with a silver substrate (Hg(Ag)FE), a lead film electrode (PbFE) and a bismuth film electrode (BiFE) [1-3]. The influence of humic substances and foreign ions on the voltammetric indium signal was examined in all procedures, which allowed for the evaluation of their practical application for direct analysis of environmental water samples. Finally the developed procedures were used for analysis of the certified reference materials: waste water and surface water as well as natural waters taken from the Lublin region: from the Bystrzyca river and the Zemborzycki Lake.

Literature:
[1] M. Grabarczyk, J. Wasąg. *J. Electrochem. Soc.* 163 (2016) H218.
[2] M. Grabarczyk, J. Wasąg. *J. Electrochem. Soc.* 163 (2016) H465.
[3] J. Wasąg, M. Grabarczyk. Anal. Methods. 8 (2016) 3605.

Catalytic activity in selective catalytic reduction of nitrogen oxides with ammonia (NH_3-SCR) of natural clinoptilolite modified with iron by various methods

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Nitrogen oxides (NO_x) are one of the most harmful air pollution emitted by stationary sources. The mixture of NO_x has a great contribution into acid rain and photochemical smog formation and ozone layer depletion. In order to abate the amount of nitrogen oxides, the governments around the world implemented a number of emission control legislations. Meeting more severe restrictions can be achieved only by using effective methods of NO_x reduction.

One of the widespread and efficient technologies used on the industrial scale is selective catalytic reduction with ammonia (NH_3-SCR). The reaction between nitrogen and the reducing agent (NH_3) takes place on the surface of the catalyst, consequently, nitrogen and water vapor are yielded. The commercial catalyst of the process is V_2O_5-WO_3(MoO_3)-TiO_2. Despite satisfactory activity above 300 ºC, it causes some operation problems. The most important are its narrow temperature window, and secondary contamination by toxic vanadia and oxidation of SO_2 to SO_3.

The mentioned problems can be solved by the replacement of the commercial system by substitutive catalyst, free of these drawbacks. One of the most promising precursors of new NH_3-SCR catalysts are natural zeolites, such as clinoptilolite. It is mainly due to its acidic character, micro- and mesopore texture and high thermal stability. Vanadium active phase can be replaced by iron species that have already found wide application in NH_3-SCR. Therefore, in the presented work, natural clinoptilolite was modified with iron by co-precipitation and adsorption from solution method and tested as a catalyst of NH_3-SCR.

It was found that even raw zeolite exhibits 56% of NO conversion at 450 ºC. Catalytic activity of the material was much higher when co-precipitation method was applied for the modification. Furthermore, when the active phase was introduced by adsorption from solution, the amount of N_2O was higher in the entire temperature range of the

reaction. XRD analysis performed in the temperature range of 100-500 ºC indicated that the structure of both the raw zeolite and the catalysts remain stable during the reaction.

Uptake, bioconcentration and mass balance of diclofenac and 4-OH diclofenac for the evaluation of their environmental fate

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The number of studies on the bioconcentration and fate of NSAIDs is clearly increasing year by year. Nevertheless, there are still huge gaps in the knowledge about this group. Diclofenac being one of the NSAIDs is one of the most widely used drugs worldwide. It is also frequently detected in marine biota. The widespread occurrence of this compound poses a great threat. However, more frighteningly, its metabolite 4-OH diclofenac has also been detected several times in aquatic environments. Some works show that the concentration of 4-OH diclofenac was even higher than primary compound. However, the uptake, further metabolism and bioconcentration of 4-OH diclofenac by aquatic organisms have not been studied so far. Another important issue is that the role of sex in the bioconcentration of pharmaceuticals is poorly known. Therefore, in the present study, the bioconcentration potential of diclofenac metabolite, 4-OH diclofenac, was evaluated for the first time and gender-related differences in diclofenac and 4-OH diclofenac bioconcentration in *Mytilus trossulus* tissues as well. In a 7-day experiment, mussels were exposed to diclofenac and 4-OH diclofenac at concentrations of 68 and 20 μg/L, respectively. What important, our study confirmed that diclofenac can be absorbed by organisms not only in native form but also as a metabolite and be further metabolized. In addition, a mass balance of both pharmaceuticals was calculated in this study and their stability under experimental conditions was analysed. The results suggest that DIC is more stable than its derivative under the conditions studied, but further analyses of the environmental fate of these compounds are needed.

Stability of magnetite nanoparticles in environmental solutions

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Nanomaterials are widely used in many areas of humans life e.g. medicine, cosmetology, IT or environment protection [1,2]. Current studies include also application of nanomaterials as e.g. water purifiers [3]. One of such promising candidate can be magnetite nanoparticles. Therefore, in this studies stability of magnetite nanoparticles in selected environmental solutions are shown. The experiments were performed by placing nanoparticles in for 1, 2 or 3 weeks in four types of liquids: treated and untreated wastewater, river water, and commercial milk (0.5% fat). Then, detailed characterization of the nanoparticles was performed, as well as amount of Fe atoms transferred into the solutions. The analysis of obtained results shows a good stability of tested nanoparticles in all water based solutions. No significant changes in their structure or magnetic properties was observed. Therefore, it makes them a good candidates to be used as, for example, detectors of specific compounds or heavy metals in aqueous solutions.

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Literature:

[1] S. C. N. Tang, I. M. C. Lo, Magnetic nanoparticles: Essential factors for sustainable environmental applications. Water Res. 47 (2013) 2613–2632
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Elimination of intereferents present in aqueous environmental samples involtammetric determination of trace concentrations of molybdenum ions

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The objective of the presented procedure was the quantification of molybdenum in environmental water samples, so research of the impact of organic matter was requisite. The most important components of organic matter present in natural water samples are surfactants and humic substances. Threfore, different kinds of surfactants, anionic (SDS), cationic (CTAB), non-ionic (Triton X-100), and biosurfactant (Rhamnolipid), as well as humic substances, such as: humic acid (HA), fulvic acid (FA) and natural organic matter (NOM), were inspected in this research. The measurements were executed in the attendance and without Amberlite XAD-7 resin for each surfactant singly. Based on literature data, according which natural waters contain surfactants with the surface-active effect similar to the effect induced by 0.2 to 2 ppm of Triton X-100 [1], we carried out our research using such concentrations of the examined surfactants. It turned out that if there is no resin in the test solution, the SDS, Triton X-100, and Rhamnolipid, in their concentrations equal to 2 mg L^{-1} causes a reduction of the voltammetric signal of molybdenum by about 80%, 90%, and 45%, respectively. Whereas, CTAB at a concentration of 1.5 mg L^{-1} caused a total decay of the Mo(VI) signal. In the case of humic substances, each of them in the concentrations of 0.2 mg L^{-1} causes total decay of Mo(VI) peak current. However, in the presence of resin, all tested surfactants did not affect the analytical signal in the whole range of concentrations (from 0.2 to 2 mg L^{-1}). In the case of humic substances, 0.5 mg L^{-1}both of HA and FA with resin did not affect the Mo(VI) signal at all, while at the same NOM concentration the Mo(VI) signal was large enough to be able to determine it [2].

Literature

[1] B Cosovic, V. Vojvodic. *Limnol. Oceanogr*. 27 (1982) 361.
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DEET as an emerging contaminant in water

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DEET (N, N-Diethyl-m-toluamide) is an organic chemical compound used as an insect repellent. It is one of the most often detected emerging contaminant in water. Along with washing the repellent from the skin, this compound may enter the aquatic environment with sewage [1]. Research has shown that the presence of this chemical in the environment may negatively affect living organisms [2], therefore the monitoring of DEET in water is gaining more interest.
The occurrence of DEET in rivers and groundwater was analyzed in five selected areas within the Silesian Province, Poland. In total, 40 water samples were collected for analysis, including 14 surface water samples and 26 groundwater samples. The study was conducted in two periods: March 2020 and November 2020. The analyses were performed using the liquid chromatography method coupled with tandem mass spectrometry (LC-MS/MS). The presence of the analyzed compound was observed in 32 water samples. In the case of 8 water samples, the concentrations of DEET did not exceed the detection limit of the method (<10 ng/L). The highest concentrations in rivers and groundwater reached 175 ng/L and 592 ng/L, respectively. In the case of samples collected in both analyzed periods, DEET concentrations were generally higher in the autumn than in the spring. This fact is probably related to the migration and persistence of the compound in the environment after the summer period, when the highest usage of preparations containing DEET is observed.

Literature:
[1] M.M. Santos., C. Hoppe-Jones, S.A. Snyder. DEET occurrence in wastewaters: Seasonal, spatial and diurnal variability - mismatches between consumption data and environmental detection. Environ. Internat. 132 (2010) 105038.
[2] J. Seo, Y.G. Lee, S.D. Kim, C.J. Cha, J.H. Ahn, H.G. Hur. Biodegradation of the insecticide N,N-diethyl-m-toluamide by fungi: identification and toxicity of metabolites. Arch. Environ. Contam. Toxicol. 48(3) (2005) 323–328.

Influence of the surfactant addition on the adsorption and volumetric properties of Acid Pure Green V

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Dyes and pigments are emitted into wastewaters from various industrial branches, such as dye manufacturing or textile finishing, and usually require special treatment strategies. An attractive alternative for this treatment provides the sorption process. It should be remember that in the dyebath there are many additives such as surface active agents (surfactants) which are responsible for a considerable change in the state of dye in solution, predominately caused by interactions between dye and surfactant. Taking this into account the purpose of the presented studies was to establish the adsorption and volumetric properties of the aqueous solutions of Acid Pure Green V in the presence of anionic (sodium dodecyl sulfate, SDS) and nonionic (Triton X-100,TX100) surfactants before and after sorption process on the strongly basic anion exchange resin Lewatit A6368A. The surface tension and conductivity measurements of the studied solutions were made in the wide range of the surfactant concentration and temperature.

The use of copper oxide nanoparticles for the construction of ion-selective electrodes with solid contact for the determination of copper ions in water

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Copper is a very important micronutrient necessary for the proper development and functioning of living organisms. In the case of copper, it is very important to observe the appropriate doses, because both the deficiency and excess of this element in the diet can cause many negative health effects. Therefore, it is very important to accurately determine the content of copper in various food products and drinking water. For this purpose, it is necessary to develop appropriate analytical methods enabling accurate, fast and selective determination of copper ions in natural samples. Among the popular methods of ion determination, potentiometry, in which ion-selective electrodes are used for measurements, can be distinguished. Recently, sensors with solid contact have become very popular, characterized by greater mechanical resistance and better possibility of miniaturization compared to classic predecessors.

In the work, ion-selective electrodes with solid contact were constructed and tested, in which copper oxide nanoparticles were used. Many types of electrodes were constructed with different contents and positions of nanoparticles (as an intermediate layer and a component of the ion-selective membrane). In order to investigate the effect of the presence of nanoparticles, the basic analytical parameters of the sensors, such as the slope and linearity range of the calibration curve, the detection limits and the response time of the sensors, were determined and then compared with the unmodified electrode. In order to determine the electrical parameters of the sensors, impedance spectroscopy measurements were also made.

"Microplastic is not fantastic" – about impact of photochemical changes on structure of microplastics

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Due to recent developments in research, plastic and its tiny particles have been deemed a hazard to all living organisms. Scientists of many different disciplines are coming together to study those man-made materials and assess their impact on our day-to-day life. The utmost attention is being granted towards smaller plastic fragments. [1]
Microplastics (MPs) are plastic particles with diameters in the range of 5 mm to 1 μm. We divide them into two categories, (1) primary MPs, which enter the environment in their small size, and (2) secondary MPs, which are a product of plastic materials aging processes. Researchers confirmed that primary microplastic is the biggest source of MPs in the world [1]. In our study, our goal was to analyze the impact of changes on high-density polyethylene (HDPE) microparticles after the accelerated photoaging test.
Using commercially bought MPs, Solar Box apparatus and UV lamps, an accelerated aging test was conducted. Then physicochemical properties of HDPE before and after said test were compared. For this purpose scanning electron microscopy (SEM) and FTIR analysis was used.
The impact of plastic particles on animals, microorganisms and humans is still being researched. However, due to how popular and widely-used this material is, this topic should be dominant for scientists across the globe.

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Section 2

Sustainable use and protection of flora and fauna

Rare and typical plant communities of the Svityazyansky Reserve (Belarus)

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The Republican Landscape Reserve "Svityazyansky" is located in the territory of Novogrudok and partially in Korelichi districts of the Grodno region of Belarus (UTM: $35UMV_2$), between 55°26.893′-55°24.911′N and 25°54.396′-25°54.433′E. The area of the Reserve is 1193.8 hectares. The maximum length from north to south is 3.76 km, from west to east 3.48 km. The reserve was created in 1970 (converting in 2007) with the aim of protecting Lake Svityaz, the unique landscapes surrounding the lake, as well as habitats of wild plants and animals species included in the Red Book of the Republic of Belarus.

All the main types of vegetation are represented on the territory of the Reserve: forest (79.2% of the protected area), meadow (0.4%), marsh (0.2%), coastal and water (~12%) vegetation. Phytocenotic diversity of forest vegetation is represented by 33 categories.

On the basis of the European nature information system (EUNIS) 13 types of biotopes have been identified on the territory of the Svitizyansky Reserve. Boreonemoral spruce-lime-oak-hornbeam forests (G1A163), Boreo-nemoral small-herb western spruce taiga (G3A34), and Permanent mesotrophic lakes, ponds and pools (C 1.2) dominate here.

In accordance with the "Technical Code of Established Practice 17.12-06-2014 Rules for the Identification and Protection of Typical and Rare Biotopes, Typical and Rare Natural Landscapes" adopted in the Republic of Belarus, 7 categories of rare and typical habitats have been identified on the territory of the Reserve on an area of 926.3 hectares (about 77.6% of the total area).

A) *Rare biotopes:*

2.1 – Mesotrophic lakes with vegetation of the class Isoteo-Littorelletea and/or Isoëto-Nanojuncetea (191.0 ha – 16.0% of the protected area);

6.7 – Nemoral deciduous forests with hornbeam (12.9 ha – 0.1%);

6.12 – Pine-oak forests (196.0 ha – 16.4%).

B) *Typical biotopes:*

6.2 – Southern taiga and subtaiga deciduous forests with spruce and hornbeam (266.3 ha – 22.3%);

6.3 – Spruce forests with rich herbaceous vegetation (228.7 ha – 19.2%);

6.6 – Black alder and pubescent birch forests on excessively moistened soils and fens (30.3 ha – 2.5%);

6.8 – Coniferous forests in raised bogs, transitional mires and fens, pubescent birch forests in transitional mires (1.1 ha – 0.1%).

In accordance with Natura 2000, the following types of protected habitats are identified in the reserve (371.8 ha – 31.1%):

3130 – Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoëto-Nanojuncetea;

9020 – Fennoscandian hemiboreal natural old broad-leaved deciduous forests (*Quercus*, *Tilia*, *Acer*, *Fraxinus* or *Ulmus*) rich in epiphytes;

9050 – Medio-European limestone beech forests of the Cephalanthero-Fagion.

A high level of phytocenotic diversity at the community level characterizes the territory of the Reserve, which corresponds to the status of a Reserve of Republican Significance, which is an important functional element of the ecological network.

Genetic and morphological variability of the American mink *Neovison vison* feral population at the edge of its invasion range

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The American mink *Neovison vison* is an alien species in Polish fauna and it has been recorded in Poland for about 40 years. Its successful invasion caused that it now inhabits most of Poland. The colonization of Poland by the American mink began in the north-eastern part of the country, then it settled in western Poland and migrated southwards, where it is scarce or still absent. Genetic studies of wild and farm-bred American minks indicate their two origins which includes the migration of wild individuals and running away of animals from the fur farms.
The aim of the study is initial verification of hypothesis that the genetic variability of the wild American mink population inhabiting the south-eastern part of Poland has decreased. Moreover, genetic similarity of the population from this part of Poland with the individuals found in north-eastern Poland will be examined. The morphological variability of the American mink will be determined from the measurements of the length and weight of the body. Minks from fur farms are larger than wild animals. As a result of natural selection, feral individuals become similar in size and body structure to wild minks in successive generations.
The first stage of the research included capturing the American mink by live-trapping in the period February-April 2021. The minks were caught on the fishpond complexes in the southern part of the Południowopodlaska Lowland, the Lublin Upland and Western Polesie. Thus far, 13 individuals of the American mink have been captured (mean 1.2 ind. per complex) which confirms their low densities in the ponds in this part of Poland. It is planned to continue catches of American mink in the summer and autumn period and their monitoring on the fishponds.

This study was supported by enabling award MINIATURA 4 from National Science Centre in Poland (Nr DEC-2020/04/X/NZ8/00615).

Do orchards maintain favorable states of small mammal communities?

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Agricultural landscapes are inhabited by a wide range of mammal species, small mammals being the main group. We tested whether small mammal communities (SMC) in commercial gardens, berry plantations and adjacent meadow habitats were formed according to the rule of equal representation of functional groups. When the difference between the numbers of species in these groups is >1, the state of SMC is considered unfavorable. The material for this study was collected in 2018–2020 at 18 sites across Lithuania, subjected to various degrees of disturbance. Out of 37 year×site cases in 20 SMC were of non-favorable state being strongly dominated by granivores (70%, 95% CI = 48.1–85.5%), while herbivores dominated in three cases (15%, $p < 0.001$, large effect size). Omnivores dominated in one case, while granivore and herbivore co-domination was registered in two cases. In 15 year×site cases, SMC state was favorable, with no prevalent domination of any functional group. Non-favorable states prevailed in apple orchards (65% of cases, $w = 0.445$, medium effect size), these strongly dominated by granivores. In plum orchards and raspberry plantations, the ratio of favorable to non-favorable statuses was close to 1:1, non-favorable communities in these cases were also dominated by granivores. In currant plantations, favorable statuses insignificantly prevailed. Intensively managed orchards were characterized by non-favorable SMC (64.3%), dominated by granivores. In the orchards with medium agricultural intensities, the prevalence of non-favorable states was not significant (small effect size), while under low agricultural intensity the ratio of statuses was 1:1. Non-favorable SMC prevailed in the old age crops (63.1%, medium effect size). In medium-aged and young crops, the ratios of favorable to non-favorable statuses were 1:1. We conclude that apple orchards, raspberry plantations, intensively managed and old age crops are most frequently dominated by granivore species, therefore form non-favourable SMC.

Changes in bird communities throughout secondary bilberry pine forest succession in south-western Belarus

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In the process of secondary succession of bilberry pine forests in southwestern Belarus, 6 stages of vegetation development were identified from a fresh clearcut to a 90-year-old forest. The field work was performed in the years 1996–2018 in south-western Belarus in the Brest timber enterprise (Tomashovka, Medno and Domachevo forestries), in the Malorita timber enterprise (Pozhezhin and Malorita forestries), in the Ivatsevichi timber enterprise (Ivatsevichi and Bronnaya Gora forestries) applying the conventional bird count methods. In parallel with the regular change of vegetation, the succession of bird communities also occurs. In the course of study, 56 bird species belonging to 11 orders were registered, the passerine birds predominate at all stages of succession (66.8–100.0% of the total number of species). The study revealed that the bird species diversity in the course of succession (6 stages, 1–90 years old) increased from 10 to 45 species, total abundance – from 159.2±1.25 to 687.0±3.80 birds/km², total biomass – from 5.71±0.25 to 31.34±1.10 kg/km². As the age of the main tree species increases, the number of birds nesting in the trees rises and reaches the maximum at the last two stages, 33 (73.3%), while the share of ground-nesting species falls. The ornithological diversity included six faunal types. At the initial stages of succession the bird population comprised the European, European-Turkestan and Palearctic types of fauna. At the stage of 80–90 years old the species structure (55.6%) and the total biomass (47.7%) were dominated by the Palearctic types of fauna, and the bird population (48.6%) were dominated by the European types of fauna.

At various stages of succession, 3 species included in the Red Book of the Republic of Belarus (2015) were identified, and 25 species are of international conservation significance.

Roadkills as a method to monitor raccoon dog populations

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The raccoon dog (*Nyctereutes procyonoides*) is one of the most frequently killed species on Lithuanian roads. As an invasive species, up-to-date knowledge of population sizes, trends and spatial distribution is critically important for species assessment and control measures. In Lithuania, however, *N. procyonoides* surveys have not been carried out since 1997. We tested therefore whether roadkill counts on predefined routes could be used as a proxy for a survey. Our dataset includes survey numbers for the period 1956–1997, hunting bag sizes for 1965–2020 (including spatial distribution in 2018–2020) and roadkill data relating to 1551 individuals between 2002–2020 (Figure 1). Additionally, a 65 km stretch of the A14 main road was checked every week across all seasons between 2009 and 2017. We found a strong correlation between the numbers surveyed and hunted (r = 0.90) and between those hunted and the number of roadkills (r = 0.56–0.69). Therefore, roadkills counts may be used as a proxy for a survey. Spatial details of this dependence and proposed method will be discussed.

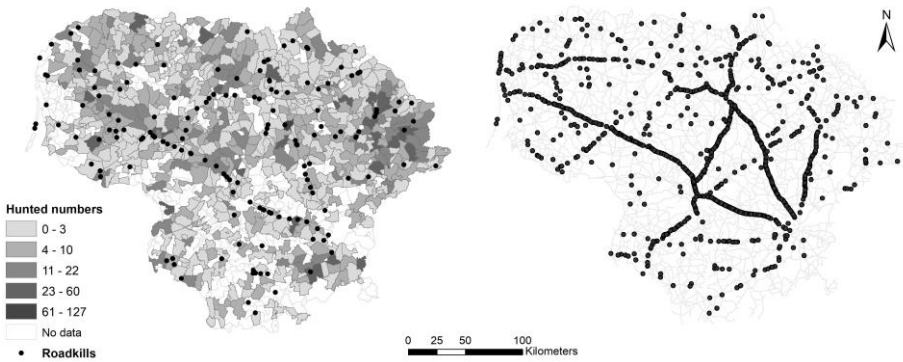


Figure 1. Spatial distribution of the number of hunted raccoon dogs in 2018–2020 (left) and their roadkills registered in 2002–2020 and (right)

Ura Grodno: Together we can do more!

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The experience of participation of the secondary school № 12 of Grodno in the implementation of the local environmental initiative "URA Grodno!" of the project "Public involvement in environmental monitoring and improvement of environmental management at the local level", funded by the EU and implemented by UNDP in partnership with the Ministry of Natural Resources and Environmental Protection of the Republic of Belarus is presented. A description of innovations and effective tools, brief characteristics of the most significant events of the initiative are given.

Long term changes of crustacean zooplankton communities in lake Wigry as a response to changing trophic conditions – 100 years observations

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Wigry Lake had one of the longest zooplankton data set in Poland and has been investigated for over 100 years. Therefore, our goal was to present long-term changes in zooplankton structures against the background of changing trophic conditions. The species composition of crustacean zooplankton in the first half of the 20th century was typical for the large mesotrophic lake with a high share of *Daphnia cucullata* and stenotherm species: *Eurytemora lacustris, Heterocope appendiculata, Cyclops lacustris*, *Bythotrephes brevimanus*, *Daphnia longiremis*. The results of the research from the years 1965-1985 were very pessimistic because the lake was exposed to intense eutrophication and there were important changes in the zooplankton communities. The glacial relicts and species characteristics for low trophic condtions declined, while the share of species typical for high trophic (*Mesocyclops leuckarti*, *Thermocyclops oithonoides*, *Diaphanosoma brachyurum*) increased. As a result, species characteristic for eutrophic conditions created up to 70 % of crustacean zooplankton, when in 1921 does not exceed 25%. The results of hydrochemical and biological studies of the last 30 years indicate a gradual tendency to improve the trophic state of Lake Wigry, due to biomanipulation activities carried out in the lake and its catchment area. We also have observed a marked increase in the occurrence of glacial relicts and the dominance of large *Daphnia* individuals, which indicates an improvement in water quality.

Impact of water quality on summer bacterioplankton in springs of Gryżyński Landscape Park

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The aim of the study was to analyze hydrochemical and bacteriological features in selected springs of the Gryżyński Landscape Park (GLP) in western Poland. The basic hydrochemical parameters as well as the abundance and biomass of bacteria were analysed in water samples collected from 22 springs of GLP in July 2018. The hydrochemical composition of the GLP spring waters depends mainly on the specific geological structure and character of catchment land use. The research showed significant differences in the water quality of GPK springs in the case of many hydrochemical parameters, e.g. dissolved organic carbon concentration, biogenic substances which influence the bacterial abundance and biomass.

The average bacterial number (BN) in the waters of the Gryżyński Landscape Park springs was 0.656 10^6 cells/ml with the range from 0.181 10^6 cells/ml to 1.656 10^6 cells/ml. The coefficient of variation of this parameter was 75.67%. In 12 investigated springs of GLP BN was below 0.5 10^6 cells/ml, in 6 springs the average BN was between 0.5 and 1 10^6 cells/ml and in 4 springs BN it was in the range from 1 to 2 10^6 cells/ml.

The mean bacterioplankton biomass was 22.98 µgC/l and from 6.35 to 61.54 µgC/l. On the basis of the collected material many correlations between BN and selected water quality parameters were found (redox potential, temperature, phenolics, phosphates, nitrites, and dissolved organic carbon).

The microbiological condition of investigated springs depends mostly on the geological structure of the spring nisches and water quality. Moreover, the research shows that GLP springs are very sensitive to human activity in the direct catchment. This research indicates the potential possibility of using hydrochemical and microbiological

parameters to assess the ecological condition of lowland springs or in planning protective measures.

The litter per litre - Spatial and temporal changes in the microplastic pollution in two lowland rivers of NE Poland

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Human impact on environmental change is enormous. One such change, affecting the entire aquatic food chain, is the pollution of the environment with microplastic particles (MP). Our study was focused on spatial and temporal changes in the microplastic pollution and impact of sewage treatment plants from two Polish cities on the rivers that flow through them. The research was conducted along the course of two lowland rivers with different degree of urbanization: Biala and Czarna Hancza flowing through the cities of Bialystok and Suwalki respectively. A total of 10 sampling sites were selected, 5 on each of the rivers. The selection of the sites took into account the different degree of urbanization as well as the location of municipal sewage treatment plants. Samples were taken within 7 months: from March to September 2019, from all 10 sites. Plastic particles were counted and divided into size fractions, groups by colour and shape. Our study shows that the average content of MP in Biala and Czarna Hancza River is similar and achieves values: 10,87 particles/L for and 10,29 particles/L respectively. The smallest amount of MP was recorded in July in the Czarna Hancza River - 4,88 particles/L - this was collected during the dry season and 5,12 particles/L in April in Biala. The most numerous fractions of plastic were particles of size 1-2 mm. In general, film was the most common shape among the collected microplastics in both rivers, accounting for 47,7% in the Biala and 52,6% in Czarna Hancza. No samples were found completely free of MP. The greatest variation in the amount of MP was observed under different weather conditions - 23.6 particles/L in the Biala River occurred in a sample collected after a thunderstorm, while in the Czarna Hancza River the most polluted samples were collected in March - 24,16 particles/L, indicating a strong supply of MP to the river from the catchment along with snowmelt and the wastewater treatment plant. It is also significant that particles smaller than 0.5mm were found in every sample collected during the study. Such small plastic particles

are very important as they enter the food chain of aquatic fauna and consequently pose a huge threat to the environment.

Low reproduction efficiency may threaten *Betula humilis* growing in north-eastern European wetlands

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Wetlands are extremely valuable reservoirs of biodiversity. Unfortunately, European wetlands have been constantly declining through drainage for agricultural use, urban development and forestation, leading to decrease of numerous fauna and flora populations. One of endangered plant species included in Polish red list of threatened wetland species is the shrub birch *Betula humilis* Schrk. As the maintenance of population abundance depends strongly on effective sexual reproduction, the aim of this study was to analyse seed and pollen qualities in shrub birch populations in comparison with reproductive performance of sympatrically growing tree congeners: *B. pendula* and *B. pubescens*. To test pollen quality, *in vitro* germination of pollen grains was carried out. Seeds quality was assessed based on the germination experiments and embryo development examination. Shrub birch seed germination ability was significantly lower than that of tree birch seeds. Low germinability of *B. humilis* seeds resulted mainly from the high proportions of empty seeds and of seeds with partially developed embryos. Low quality of shrub birch pollen was also revealed. The germinability of shrub birch pollen was significantly lower than that of tree birch pollen; thus, pollen swamping is likely to decrease *B. humilis* fitness. We conclude that qualitative pollen limitation and lowered seed quality of *B. humilis* compared to its widespread tree relatives may threaten its populations in north-eastern European wetlands.

This work was supported by the Polish National Science Centre under the grant No. 2016/23/N/NZ8/03054.

Size and status of the population of *Dactylorhiza majalis* in the Rządza river valley depending on the frequency of mowing the meadows

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There are numerous meadow objects of high natural value in the agricultural landscape of Mazovia. Wet meadows with patches of protected species are especially valuable. The aim of the study was to assess the size and status of the populations of *Dactylorhiza majalis* in the Rządza River valley depending on the frequency of mowing of wet meadows. The study was carried out during the flowering of the orchid (May/June, 2019-2020) in meadows located in the upper section of the river, over a length of 12 km (Jakubów commune). The assessment of 11 populations of *D. majalis* was performed on the basis of biometric measurements of 10 individuals from each population (height, length of the inflorescence, length and width of the largest leaf, number of flowers, number of leaves). Vegetation accompanying *D. majalis* was identified based on an analysis of phytosociological relevés (Braun-Blanquet method), and the habitat conditions - by the phytoindication method (Ellenberg index numbers). Five objects were cut once a year, three were cut twice a year, one plot was cut every two years, and two were fallow for 4 years. From the meadows that were cut once a year, the biomass was not removed. The largest number of *D. majalis* shoots was found in the meadows cut once a year (av. 242), and the lowest in the meadow cut every 2 years (26). Plant height ranged from 16 to 56.5 cm. In 1-cut meadows, with weaker sodding, the shoots were taller, had longer inflorescence and more leaves than in 2-cut meadows. The longest leaves were found on the fallow plots. The number of flowers in the inflorescence was less determined by the frequency of mowing. The species that accompanied *D. majalis* were mainly: *Holcus lanatus* L., *Ranunculus acris* L., *Lychnis flos-cuculi* L., *Anthoxanthum odoratum* L. *Poa pratensis* L., *Festuca rubra* L., *Rumex acetosa* L., *Ranunculus repens* L., *Plantago lanceolata* L.

Biotope impact on Fluctuating asymmetry manifestation in Ground beetles *(Coleoptera, Carabidae)*

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In our study we used the replenishing data set on morphimetric traits in ground beetles species. In this case we have selected data on nine species for which the left and right sides had been measured and fluctuating asymmetry (FA) could be estimated. 150 samples were from 6 provinces of Russia and Belarus. FA was recorded in 5265 specimen in one dimensional trait and one - meristic. Biotope, species and their interaction affected FA in both traits, that is different species reacted differently to biotope type. In uncommon biotopes FA was increased. In forest species the negative relationship between FA in dimensional and meristic traits was revealed. In those species only FA values were sex-biased. In generalist species FA varieв similarly in both sexes and in both traits being the highest in open biotopes. In eudomonant of arable lands biotopes – *Poecilus cupreus* – the highest values of FA were recorded in the meadows, being about equal in all types of crops.

Biotesting of plastyfing additives used for production of polystyrene concrete

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A study of plasticizing additives used for the production of polystyrene concrete with the help of higher plants of seed radish (*Raphanus sativus*) and small duckweed (*Lémna minor*) was carried out. It is proved that plasticizing additives have toxic effect on duckweed, and no toxic effect on the seed radishwas detected for polystyrene concrete.

The values of the toxicity index for different concentrations of polystyrene concrete are calculated according to 5 indicators of the TIF (the toxicity index of the test function): TIF 1 – germination rate, TIF 2 – seedling vigor, TIF 3 – seedling stem length, TIF 4 – seedling root length, TIF 5-seedling mass. The average toxicity index (TIF cf.) was also determined and the Kabirov environmental toxicity class was determined [1].

Evaluating the results of the study, we can say that polystyrene concrete does not have a toxic effect on radish plants when applied to the soil in concentrations from 100 to 1000 mg per 100 grams of soil.

The values of the toxicity index for different concentrations of plasticizers are calculated according to 4 indicators: TIF 1 – the total number of duckweed leaves, TIF 2 – the number of leaves that have retained their green color, TIF 3 – the number of dead cells (according to safronin staining),TIF4 – the reproductive potential [1].

When comparing the three additives in the same concentrations, all the additives are the least toxic to duckweed plants (*Lémna mínor*) in concentrations of 0.01 %, 0.1% and 0.5%. The lowest values of the toxicity index at a concentration of 0.01% are characteristic of stachement, and at concentrations of 0.1% and 0.5% – for relamix.

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Section 3

Ecological biochemistry, physiology and medicine

Report from the battlefield: the model of *Malassezia pachydermatis* resistance to polyenes

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Drug resistance is a very important research problem in modern biology, medicine and veterinary. Interestingly, in the light of the increasing number of fungal infections it is still relatively poorly understood among that kind of opportunistic pathogens [1,2,3].
The aim of our study was to compare the response of *Malassezia pachydermatis* strains to nystatin and natamycin during long-term exposure. For experiment 10 strains were selected, with initial mean MIC and MFC values equal to 11,2 μg/ml and 12,8 μg/ml for nystatin, as well 17,6 μg/ml and 25,5 μg/ml for natamycin, respectively. All strains cultures were carried out on solid YPD medium supplemented with antibiotic at a concentration 2-fold lower than the initial MIC value. Strains were passaged every 7 days for 80 weeks.
As a result the mean MIC value for nystatin increased twofold, simultaneously the MFC increased by 70%. For natamycin, the mean MIC value rised by 85% while the MFC reached 130% of initial value.
In conclusion, we obtained a model of resistance to nystatin and natamycin that will be useful for explanation of mechanisms of antimycotic resistance development and evolution.

This study was partially supported by a grant (DEC-2019/35/D/NZ27/02094) from the National Science Centre, Poland.

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Profiles of antibiotic resistance among members of *Bacillus cereus sensu lato* isolated from synanthropic birds

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Bacteria act as an integral part of the environment and display a significant impact on the economy and public health. *Bacillus cereus* sensu lato is a group of several different species so far relatively poorly studied. They are ubiquitous in natural habitats, food products and digestive tracts of animals. They are usually regarded as commensals, however recent data suggest their role in pathogenesis of different infections and food poisoning. Several reports proved antibiotic resistance among *B. cereus* sensu lato, especially in relation to *B. anthracis* obtained from clinical cases, however the remaining taxa are still explored only in a part. In consequence, the goal of our study was to evaluate the hypothesis that different members of *B. cereus* sensu lato coming out from synanthropic birds may carry genes responsible for antibiotic resistance.

For the purpose of the study we isolated 100 *B. cereus* sensu lato strains, which underwent precise taxonomic identification and the assessment of their resistance patterns including disc diffusion screening tests and determination of minimal inhibitory concentrations (MICs) using gradient stripes.

We found out that the resistance among *B. cereus* sensu lato strains is common, especially in relation to β-lactams. In case of remaining tested drugs (representing quinolones, tetracyclines, macrolides, aminoglycosides), sensitivity was varied. Our results are in good agreement with previous findings and prove that the commensal bacteria present in intestinal tract of synanthropic birds may be the source of antibiotic resistance. For the future we hope to investigate the level of resistance among non-target, commensal bacteria from wild birds.

Into the deep blue – antibiotic resistance of *Bacillus cereus* sensu lato from sea water

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Bacillus cereus sensu lato is a ubiquitous bacterium in natural environment commonly isolated from soil, water, plant and animals' tissues and from food products. Members of this group may cause spoilage, food poisonings and infections. Their toxicity and genetic structure or ecological properties are well-studied, however the phenomenon of antibiotic resistance among non-*B. anthracis* isolates remains mystery. Therefore, the goal of present study was to evaluate the antibiotic resistance level of *B. cereus* sensu lato from natural marine ecosystem.

For this purpose bacteria were isolated from salt water obtained at distinct locations at Baltic Sea and Mediterranean Sea and identified as described by Bartoszewicz and Czyzewska (2018). Subsequently, disc diffusion tests and gradient strips/serial dilution method were applied as described by Bartoszewicz and Czyzewska (2021). Isolates were also tested for their toxicity by the aid of immunochromatographic tests.

The obtained results show different resistance patterns among isolates with distinct origin. Most of the strains were resistant to β-lactams, which are commonly used in the therapy. In turn, most of the strains were susceptible to chloramphenicol, aminoclycosides, and tetracyclines. Numerous isolates were resistant to 1-2 therapeutic agents, however multi-resistant strains were also detected.

These findings suggest that *B. cereus* sensu lato may play a role of natural carrier of resistance genes.

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Response to long-term exposure to polyenes in *Candida albicans* strains

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The increasing resistance of microorganisms to the available antibiotics is becoming an increasingly serious problem. In the case of fungal infections, medicine struggles with diagnostic problems, small number of antimycotics, and a relatively poor understanding of the mechanisms of antibiotic resistance development [1, 2].

The aim of the study was to investigate the differences in response to polyenes among *Candida albicans* strains. Based on the estimation of MIC value, 10 most susceptible to polyenes strains from a pool of 30 strains of *C. albicans* isolated from humans and animals were selected. Afterwards strains was passage onto YPD solid medium supplemented with sublethal concentrations of nystatin and natamycin (4 μg/ml). Antibiotic concentrations were determined by half of the MIC_{50} value for the 10 selected strains. Strains were passaged every 7 days for 30 weeks.

As a result on the stage of 30 passage MIC average values for has increased for nystatin by 98 %, and 25% for natamycin. Currently MIC values for nystatin vary from 8 to 32 μg/ml, and for natamycin from 8 to 14 μg/ml. Average values of MIC_{50} and MIC_{90} for tested strains also increased, for nystatin 75% and 100%, for natamycin 50% and 16% respectively.

In conclusion, our research showed a variation in response to the long-term exposure of polyenes among *C. albicans* strains. Some of tested strains show the tendency for development of drug resistance. The model of resistance development of *C. albicans* could be used in research and significantly expand our knowledge on the development of drug resistance among yeasts.

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Plant flavonoids: antioxidative properties, biochemical activity and hepatoprotective potential

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Flavonoids, one of the main groups of polyphenols (secondary plant metabolites), are important natural antioxidants and free radical scavengers characterized by high biochemical activity and a variety of pharmacological effects. The specific qualities of polyphenols make these natural dietary pigments excellent candidates for treatment and/or prevention of numerous types of diseases. The antioxidative mechanisms of redox-active flavonoids include both inhibition of oxidative reactions, scavenging of oxygen – derived free radicals, sequestration of redox – active metals, and modulation of several pro- and antiapoptotic proteins and upregulation of cellular antioxidant defense system via activation of the Nrf2-Keap1 pathway. In our experiments the flavonoids considerably inhibited membrane lipid peroxidation in rat erythrocytes and mitochondria, treated with tert-butyl hydroperoxide (IC50 values for prevention of this process were equal to 9.7±0.8 μM, 8.8±0.7 μM, and 37.8±4.4 μM in the case of quercetin, catechin and naringenin, respectively). Flavonoids dose- dependently increased the sensitivity to Ca2+ ions - induced mitochondrial permeability transition, strongly modulate microfluidity, electrokinetic properties, size, permeability and lipid molecule packing of the liposomal membrane bilayer at different depths. The treatment of chronically intoxicated rats with cranberry polyphenols (daily, 4 mg /kg bw) partially prevented liver damage, decreasing serum and liver triglyceride, total bilirubin contents, ALT and AST activities, as well as diminishing demonstrating hepatoprotective and anti-inflammatory activities. The cranberry polyphenols restored mitochondrial functional activities in the animals, inhibited Ca2+ - induced mitochondrial permeability transition, free radical generation, and membrane lipid peroxidation in vivo. The cranberry polyphenols (25 μg/ml) effectively prevented mitochondrial oxidative impairments in vitro.

Blood proteins as an important reservoir of charged compounds in bioconcentration phenomena

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The accumulation of chemicals in biota is of major concern for environmental hazard and risk assessment. For this reason, assessing bioaccumulation is a component of international efforts to identify and control chemicals of environmental concern. Generally, membrane and storage lipids have been considered as underlying compartments in the bioaccumulation of organic chemicals. Octanol has been recognized as a reasonable model compound of the lipids in organisms and many methods for estimation the bioconcentration factor (BCF) have been developed on the basis of octanol-water partition coefficient (K_{OW}). However it must be highlighted that although K_{OW} is reliable for the bioaccumulation assessment of non-ionic compounds of moderate hydrophobicity it is not reliable for bioconcentration estimation of ionic compounds, because they do not consider the ion–macromolecule interactions of charged compounds with the heterogeneous membrane system that contains, e.g. polar and charged phospholipids. Moreover, the bioconcentration/bioaccumulation potential of these chemicals is not only defined by lipid partitioning. Knowledge regarding the partitioning of these compounds to proteins is equally important, because it may be an essential sorption phase for ionogenic chemicals. Therefore, the aim of the present study was to investigate whether binding to blood proteins may contribute significantly to the potential bioaccumulation process, for selected ionic and ionogenic compounds. Albumin and α -1- acid glycoprotein were chosen as model proteins due to their different binding properties. In order to assess the potential to bioaccumulation of selected compounds, commercially available TRANSIL test kits were used.

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In relation to the evaluation of human reserve capacity of the human body

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The human body has hidden or reserve capabilities (morphological, biochemical, physiological, psychological, etc.) [1]. Physiological reserves are the evolutionary adaptive and compensatory capacity of an organ, system and organism as a whole to increase the intensity of its activity many times in comparison with the state of relative rest [2, 3]. It is known that in everyday life, a person uses only 35 % of his reserve capabilities. Therefore, the study of the regularities of improving the physiological mechanisms of increasing the functional capabilities of the human body and the features of their qualitative characteristics, such as mobilization, functional capacity, stability in conjunction with the individual typological characteristics of the body such as adaptability, dynamics of changes in muscle activity is an especially relevant task. The solution of this task will provide information for choice of strategy for increasing the functional capabilities of the body.

In our study, we propose the following methods for estimating the reserve capacity of the human body: assessment of morphofunctional indicators (anthropometry, bioimpedance measurement; dynamometry, spirometry, blood pressure indicators, etc.), assessment of biological age and psychoemotional status, lifestyle analysis (including dietary assessment), assessment of micronutrient status (including biochemical and X-ray fluorescence analysis), genetic analysis, information and other systems in the screening assessment of the body's reserve capabilities. It is this integrated approach that will make it possible to determine the main biomarkers of the physiological reserves of the body for the development of a system (technology) of adequate monitoring and assessment of the functional preparedness of the body, the selection of adequate ergogenic means of targeted impact on the body as additional adaptogenic factors.

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Phenotyping of spring oilseed rape cultivars (*Brassica napus*) against *Alternaria brassicicola*-induced disease

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Oilseed rape (OSR, *Brassica napus*) is one of the most important crops from *Brassicaceae* family as it is used as a source of edible oil and a main ingredient in production of biodiesel. OSR is mainly cultivated in Europe, Asia and North America and is often exposed to many dangerous pathogens. *Alternaria brassicicola* is a necrotrophic fungus that causes a black spot disease in *Brassica* plants. In our study 2-week-old seedlings of spring *Brassica napus* cultivars were inoculated with *A. brassicicola* conidial suspension and were incubated in high humidity conditions for five days. Necrotic lesions on OSR cotyledons were measured using Win_DIAS Leaf Imaging System and parameters such necrotic area and necrosis diameter were estimated. Based on necrosis parameters, cultivars were divided into 5 groups from highly susceptible (e.g. Brutor, Furax) to highly tolerant (e.g. Omega, Duplo) to *A. brassicicola* infection. Moreover, changes in secondary metabolite contents such as total phenolic compounds (TPCs), flavonoid and phenylopropanoids in response to infection were measured. Interestingly, contents of investigated secondary metabolites in highly tolerant cultivars were preserved at similar levels in infected seedlings compared to the control ones.

The antioxidant systems in *Chlorella vulgaris* cells during phosphate deficiency

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Chlorella vulgaris Beijerink cultures with complete (control) or phosphate deficient (-P) liquid Knop medium were grown for 5 or 12 days. Cells from phosphate deficient cultures displayed symptoms of increased oxidative stress, e.g., higher level of hydrogen peroxide and of the lipid peroxidation products. In –P cells the activities of superoxide dismutase, ascorbate peroxidase, and the total ascorbate (ascorbate + dehydroascorbate) level were higher than in control cells. The 5-day old cultures, in contrast to 12-day old, from deficient medium displayed an enhanced excretion of vitamin C components (mainly dehydroascorbate) into the culture media. It is concluded that insufficient phosphate feeding, which limits growth and photosynthesis, intensifies the oxidative stress in cells. The efficiency of antioxidative mechanisms in *C. vulgaris* stressed cells may be limited by the absence or low activity of dehydroascorbate reductase, an enzyme in the ascorbate-glutathione cycle, that catalyzes the reduction of dehydroascorbate to ascorbate. The potentially low activity of dehydroascorbate reductase in 5-day –P cells, may be a causal factor resulting in a relative increased dehydroascorbate excretion into the media. After prolonged phosphate deficiency, i.e., up to 12-day P_i limitation, the ascorbate-glutathione cycle or the alternative pathway(s) with participation of monodehydroascorbate reductase which, directly utilizes NADPH as reductant, have an increased activity.

Rhizobia as an ecological substitute for fertilizers

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Mineral fertilizers despite its nutritional activity appeared as harmful to an environment. These artificial fertilizers contaminate environment with above normative amounts of nutrients and cause changes in habitats *e.g.*, by an eutrophication [1]. Rhizobia can provide an natural alternative to above mineral nutrients. They are Gram-negative, slime producing *Proteobacteria* that exhibit a high taxonomic diversity, express a specificity in symbiosis with plant partners, entering in mutualism in wide types of climate. When free living they use to be the saprophytes but when in a symbiosis they fix atmospheric nitrogen, reduce it into ammonia, and incorporate it for example in proteins [2,3]. As a consequence, legumes may serve as a significant source of biomass highly useful in hummus development.

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Plant growth promoting traits in metal contaminated environment

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Plant growth promoting bacteria (PGPB) represent a group of microbes able to improve plant growth in variable environmental conditions. Bacterial accelerated stimulation of a plant growth and development in areas such as these polluted with metals, can be performed in three main ways, *i.e.*, (1) synthesis of compounds used by plants, (2) increase in bioavailability of nutrients, and (3) inhibiting pathogens and preventing plant infections. A synthesis of compounds used by plants involves phytohormones, *i.e.*, auxins, gibberellins, cytokinins, ethylene and abscisic acid as well as rhizobitoxin and 1-aminocyclopropane-1-carboxylic acid deaminase (ACCD). Enhanced nutrient bioavailability, provided by bacteria, is usually performed by, *e.g.*, diazotrophy, increase in a solubility of inorganic phosphates and organic phosphorus mineralisation as well as organic acid and siderophore synthesis. Microorganisms, equipped in mechanisms of an indirect beneficial influence on plants, affect pathogens growth and development by triggering induced systemic resistance (ISR) in plants, secreting enzymes that induce pathogen cell wall lysis (*e.g.*, chitinase, β-1,3-glucanase, protease, lipase), and synthesizing antibacterial and antifungal metabolites, *e.g.*, ammonia, hydrogen cyanide, viscosinamide, oomycin A or xanthobaccin, and (4) competing with pathogens for limited nutrient resources (*e.g.*, iron chelating siderophores synthesis).

Water stress affect morphogenesis of flax (*Linum usitatissimum* L.) in *in vitro* cultures

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The processes of morphogenesis are influenced by many external and internal factors, including stress factors. The introduction and proliferation of plants or their parts *in vitro* may alter oxidative metabolism and predispose tissues to the damaging effects of reactive oxygen species. The aim of this study was to investigate the effect of water stress (physical and chemical desiccation) on cultures growth and organogenesis of shoots and roots from hypocotyl explants of oil flax.
Hypocotyl explants of 7-day old seedlings of flax (*Linum usitatissimim* L., cv. Szafir) were cultured for 4 weeks *in vitro* on Murashige and Skoog medium supplemented with BA (1 mgl^{-1}) and 2,4-D (0.05 mgl^{-1}). Water stress was obtained by: a) incubation of explants on MS medium supplemented with 6- or 9% of sucrose, instead of 3% in the control; b) fast drying of explants for 30 or 45 minutes in cabin with flow of sterile air; c) slow drying of explants in closed Petri dishes on soft filter paper for 48 or 72 hours.
Stressed explants showed lower water content and fresh mass, higher lipid peroxidation and H_2O_2 concentration than control. The rhizogenic processes in stressed cultures were five times higher than in control after desiccation time, whereas the rate of roots regeneration after 30 days of growth were similar in both cultures. Although the rate of shoot organogenesis in control and stressed cultures were similar.
Chemical desiccation, in contrast to physical one, maybe via signaling molecule H_2O_2, positively affects some organogenic processes in flax cultures, leading to enhance the rate of roots organogenesis. It is worth to note, that in spite of limitation of growth processes of stressed cultures, the rate of shoots organogenesis is similar as in control ones.

Chlorophyll fluorescence signals as a future tool to provide plants with autonomous control over their growth environment

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Photosynthesis is the most important process on earth, not only for plants but also for all other living organisms. It is a very sensitive process that can indicate any changes in the physiological status of plants. First, the measurements of photosynthesis were based on a destructive method using homemade equipment. Later on, at the end of the eighties, very rapid development in computer science and electronics allowed manufacturers to produce portable, computerized, and very advanced instruments that allow live measurements of plant photosynthetic performance and chlorophyll fluorescence signals in a short time and in a non-destructive way. Nowadays, we are able to monitor the state of plants by using specialized devices and systems, remotely. Such systems allow not only monitoring the plants alive but also predicting changes that will be visible after a few days or even a few weeks. The next step will be the application of complicated data analyses including Artificial Intelligence (AI), Machine Learning, and Deep Learning to allow the identification of specific stressor types. While the far future step is to build a biological feedback system that allows plants not only to inform us about their actual physiological status and needs but also to control their growth environments. The first step has been partially done.

Nanoparticles in food industry

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Nowadays is hard to find an area of human activity where nanotechnology is not present. Modern nanomaterials become very advanced and are used in many fields of science and production, e.g. electronics, automotive, construction, medicine, pharmacy, environmental protection as well as food industry [1]. Continuous development of a new nanosized products brings innovative applications and attractive solutions, especially in the food industry. Thanks to this food becomes safer, healthier and has better quality. Various nanomaterials are used as sensors for the detection and determination of: bacteria, viruses and pesticides presence in order to maintain food safe for consumption. Nanoparticles are commonly also applied in pasteurization and nanocapsulation in food science and agriculture [2].
The most commonly used nanomaterials in the food and environment related fields are: gold, silver, silicon, and magnetic nanoparticles [3].
This presentation will be a brief overview of the use of the most frequent nanoparticles in food related nanotechnology.

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Fecal glucocorticoids as indicators of stress in Capercaillie (*Tetrao urogallus*)

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The success of an active conservation of the endangered Tetraonid species - the Capercaillie hinges on the responses of individual birds to environmental stress. Those responses involve secretion of glucocorticoid hormones after activation of the hypothalamic-pituitary-adrenal axis. The level of fecal glucocorticoids (FG) is considered as a reliable biomarker of individual stress adaptation. We developed the method of quantitative measurement of FG based on the ELISA immunoassay and applied it to analyse 231 fecal samples collected in the captive as well as wild population of Capercaillies from the Augustowska Forest. Our analysis revealed significant, within-individual repeatability of the FG, with individuals older than one year manifesting higher FG levels. We however, did not detect systematic differences between sexes nor wild and captive populations. Conversely, the FG levels significantly differed between seasons, with highest levels recorded in winter. Overall, our results suggest that captive individuals do not suffer from excessive stress. High between-individual FG variation, detected in our study, may constitute a useful indicator of the survival prospects of captive birds released to the wild.

Section 4

Rational use of natural environment resources and environmental protection

Activated sludge microbial community of industrial wastewater treatment plants

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One of the most effective methods of wastewater treatment is a biochemical method that almost completely disposes various dissolved organic matter. To increase the oxidizing capacity of bioreactors and control the biochemical processes of wastewater treatment, it is necessary to determine the microbial diversity of activated sludge under the influence of specific factors.This study was expected to provide a more comprehensive understanding ofactivated sludge microbial communities in full-scale industrial WWTPs. It was aimed to characterize microbial community diversity and structure of 4 sewage sludge from treatment plant of nitrogen compounds production. The relationship of the microbial community with the physico-chemical properties of wastewater, redox and hydrodynamic conditions of sources of activated sludge [biorectors for nitrification and denitrification, aerotanks 1 and 2] was established.

All sludge revealed high microbial diversity. Nitrifying microbial community consisted of loose flakes with high amount of filamentous (156–495 ind./cm^3), which determines its low sedimentation properties (SVI 260–360 cm^3/g). Its microfauna was notable for its low species diversity, with the dominant shell amoeba *Euglypha* as an indicator of easily oxidized organic matter entering the bioreactor. Anaerobic denitrifying microbial community included many dispersed bacteria due to the absence of microfauna. The denitrification sludge flakes were 0.27–0.76 mm^2 and, as a consequence, high sorption and dehydrogenase activity. In aerotanks, intensive aeration and low concentration of wastewater promoted the high development of floccule-forming bacteria *Zoogloea. ramigera* and a high species diversity of microfauna. The dominants of this sludge are the testate amoebae *Arcella* and *Euglypha*, sessilid peritrich ciliates *Thuricola*, armored rotifers *Lecane*, and rotifers *Rotaria*.

Application of d-electron metal ions/peracetic acid in UV stabilizers degradation

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UV stabilizers are substances added to polymers to decrease the chances of photodegradation of plastic materials. This group of compounds includes phenolic benzotriazoles (BZT) with an additional benzene ring fused to the benzotriazole molecule. The primary use of phenolic BZTs is as UV stabilizers in plastics, films, paints, inks, and other coatings [1]. Benzotriazoles are an environmental problem because they are ubiquitous and they are found everywhere, in house dust, wastewater, and sewage sludge [2,3]. UV-BZTs are difficult to degrade and may accumulate and cause toxic effects on living organisms [4,5]. Due to the lack of effective removal of UV-BZTs by sewage treatment plants, they end up in the environment, damaging the ecosystem. A method of efficient removal of compounds from the group of UV stabilizers by oxidation with peracetic acid activated with d-electron metal ions has been proposed. The results obtained in the Fe^{2+}/PAA and Co^{2+}/PAA systems indicate that peracetic acid can effectively remove benzotriazoles. Reaction rate constants according to first-order kinetics in Fe(II) and Co(II)-based processes are 0.0059-0.0150 min^{-1} and 0.0118-0.0166 min^{-1}, respectively.

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The use of floating plant to remove benzotriazoles from water and wastewater

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Due to their common occurrence and wide application, benzotriazoles (BTs) are among the groups of substances that constitute a current environmental problem. They are used as corrosion inhibitors in the mechanical and metallurgical industries, as well as in households as dishwashing liquids [1]. BTs are stable, have a limited sorption capacity, do not photodegrade, form very stable metal complexes, are polar, and not very volatile [2]. They occur in the environment in very small amounts (from hundreds ng/L to tens μg/L) [3], but exposure to them is chronic. Moreover, they pose a threat to living organisms because they are able to disrupt the functioning of the endocrine system [2]. Due to BTs properties, wastewater treatment plants cannot cope with their complete removal. Therefore, new ways of removing them are being searched for. In the presented work phytoremediation using floating plants is proposed. Research on the use of *Wolffia arrhiza* to remove BTs has shown that the effectiveness of this process is 23-100%. Removal of BTs takes place both through biological processes, as well as through hydrolysis and sorption.

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Application of low-cost alginate-based biosorbents for the effective rare earth elements recovery

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Rare earth elements are used in many high-tech applications but their rarity and availability require the development of methods for their recovery from low-quality sources and recycling from waste materials. Sorption processes, including biosorbents, are interesting method for their recovery from dilute solutions. This work investigates the sorption of lanthanum(III) ions using a cheap, renewable biosorbents: calcium alginate and biochar (considered as a reference materials) and alginate-based biosorbent named as alginate-biochar composite (ALG-BC). Sorption properties comparison of these materials were performed using batch-adsorption techniques, studying different sorption conditions. The obtained sorption results show the applicability of the biosorbents for the rare earth elements recovery.

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Iron-modified clinoptilolite as a catalyst for the SCR process in nitric acid plants

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NO and NO_2 - together referred to as NO_x, emitted from nitric acid plants are dangerous for humans and the environment. They cause serious health problems, contribute to the formation of acid rain and a photochemical smog. In order to reduce NO_x emissions from the industrial sectors, the European Parliament issued a relevant IED (Industrial Emission Directive), which obliges EU countries to significantly reduce emissions of nitrogen oxides (NO_x), among others from nitric acid plants [1]. One of the most effective methods to reduce NO_x emissions from nitric acid plants is a selective catalytic reduction of nitrogen oxides by a reducing agent, usually ammonia (NH_3-SCR). Various types of catalysts are used, depending on the operating parameters of the SCR unit.

Preliminary studies have shown, that an interesting catalytic material is the most abundant natural zeolite - a clinoptilolite. By modifying clinoptilolite with transition metal ions (e.g. iron, copper), its potential as a catalyst for the SCR process can be increased. As a part of the presented research, shaped samples of the catalyst were obtained. The support was modified with iron by precipitation method. The activity of the catalyst in the selective catalytic reduction process was tested in a laboratory scale using tail gases from a pilot nitric acid plant with a composition similar to industrial gases in the temperature range of 250-450^{o}C at GHSV= 4500 and 9000 h^{-1}.

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The study of the migration of toxic and potentially toxic elements from toys

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Children are particularly sensitive to contaminant exposure due to their physiological and developmental properties. Object mouthing is a common behavior for children, especially high for infants (6-12 months) and toddlers (1-3 years). Exposure of children to metals in toys due to object mouthing or via ingestion may significantly add to the present carcinogenic and noncarcinogenic risks from other sources.

The aim of this work was study the migration of toxic (As, Cd, Pb) and potentially toxic elements (Cr, Co, Cu, Ni, Mn, Se, Zn) from toys. Toys of the 1st category [1] were tested for migration of 10 elements with the use of the EN 71-3 (0.07 mol/L HCl) [2] and RIVM (model solutions of physiological fluids) [3] procedures. The analytes in toy extracts were determined by optimized ICP-MS method with the use of the ICP-QQQ mass spectrometer equipped with a collision / reaction chamber ORS^3 to remove of spectral interferences. The results of migration obtained with the EN 71-3 and RIVM procedures were compared and statistically evaluated. The obtained migration values were compared with the permissible limits included in Directive 2009/48/EC [1]. The allowable level of element migration was not exceeded in any of the analyzed toys. Additionally, due to toxic properties of Cr(VI) form, the study of chromium speciation in toys by ion pair revere phase HPLC-ICP-MS method was also performed. The risk assessment of the child's exposure to the elements present in the toys was determined on the basis of the HI index.

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Spring water quality in Grodno: to drink or not to drink

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In many countries, including Poland and Belarus, one of the important tasks in terms of ensuring ecological safety and a favorable environment is the protection of local and regional ecosystems for present and future generations. In Grodno, the inhabitants commonly use spring water for drinking, even if they are supplied with tap water. The study included six springs located in the Neman river basin in Grodno. Water tests were conducted on November 2020. Physical and chemical water analyses were carried out in the laboratory of the Ecology Department, Yanka Kupala State University of Grodno in accordance with ISO standard methods. All collected results were used for the general characteristics of water quality and compared with hygienic standards.In the field, the flow rate of the springs was investigated. Spring No.2 showed the highest flow rate which amounted to 3.28 ml/min.Water from springs was characterized by average temperature of 8.7°C and slight alkalinity (pH = 7.8–8.3).In the springs No. 3, 4, 6, the water color was more than twice as high as the limit value in the sanitary standard.Oxygenation was within the range 0.3–2.7 mg dm^{-3} and the hardness index do not exceeded 7 mmol dm^{-3}.The total concentration of iron ions, nitrates, sulphates and chlorides did not exceed the sanitary standards. Compared to the autumn period of 2019, the oxidation, mineralization and content of sulphates and nitrate ions decreased. The following values of water parameters increased: pH, hardness index, total Fe (springs No. 4 and 6), and chloride ions concentration. The high variability of water parameters indicates the need for continuous monitoring of water quality, which allows for timely informing of water users about the existing health hazards.

The use of phenol-formaldehyde sorbent in the process of acid and reactive dyes removal from aqueous solutions

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Acid dyes belong to one of the most numerous groups of dyes. They are used in the form of sodium salts of sulfonic acids, less commonly found in the form of salts of carboxylic acids. The group of these dyes belongs to strong electrolytes, which in aqueous solutions are completely dissociated into colored anions. Their permanent bond with fiber can be achieved by adding acids to the dye bath. In terms of chemical structure, they are azo dyes (mono- and diazo). Azo dyes are the most important class of synthetic organic dyes used in the textile industry and therefore can be considered as common industrial pollution [1]. They are produced in large quantities and get into the environment during production processes. Therefore, there is a need to look for new low-cost and effective methods of their elimination from wastewater [2].
The removal of C.I. Acid Violet 1 and C.I. Reactive Blue 21 dyes from the aqueous solutions by a phenol-formaldehyde sorbent was described. The sorption process of the dyes was investigated by a static method. The adsorption parameters were determined based on the Freundlich, Langmuir and Temkin isotherm models.

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Removal of vanadium(V) by adsorption onto ion exchangers from aqueous solutions

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Many researchers are interested in trace metals and metalloids such as vanadium due to its potential use as well as high toxicity to biota [1-2]. Vanadium (V) as widely distributed in the earth's crust and has been recognized as a potentially dangerous pollutant. Based on the toxicity vanadium is classificated in the same class as mercury, lead and arsenic [3]. Moreover, its removal from water and wastewaters is also an important environmental issue [4]. Adsorption is a one of physico-chemical technique which could be applied in V(V) removal with high efficiency e.g. vanadium removal (%R) from molybdate solution on strongly basic ion exchange resin D296 (%R > 99.5%) [5] or its removal from ammonium molybdate solutions on chelating ion exchangers (%R after 30 min > 98%, optimal pH = 7.42 - 8.02, desorption efficiency 99.6%). Therefore in the present study, V(V) removal from aqueous solutions by different ion exchangers was investigated. After optimization of adsorption conditions the effect of pH as well as phases contact time on the V(V) removal efficiency were studied. The obtained results shows that optimal pH was about 6 and V(V) can be removed with high efficiency (q_t = 9.75 mg/g; %R = 97.6% - gel Dowex resin or q_t = 9.86 mg/g; %R = 98.6% macroporous Dowex resin).

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Kinetic studies on acid, direct and reactive dyes removal from aqueous solutions using strongly basic anion exchanger

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Intensive development of many industries, including textile, paper or plastic, which consume large amounts of water and generate huge amounts of wastewaters containing toxic dyes, contribute to pollution of the aquatic environment. Among many known methods of wastewater treatment, adsorption techniques are considered as the most effective. In the present study the strongly basic anion exchanger such as Lewatit 5528 was applied for C.I. Acid Violet 1, C.I. Direct Yellow 142 and C.I. Reactive Blue 21 removal from aqueous solutions (Figure 1).

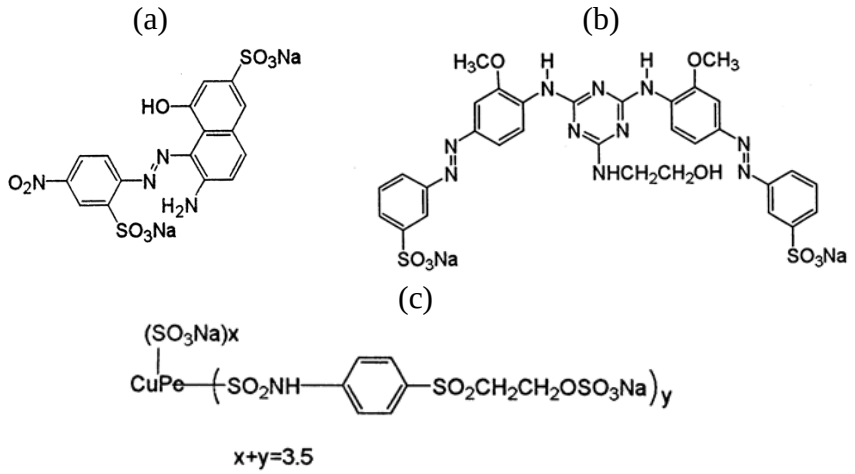


Figure 1. Structures of C.I. Acid Violet 1 (a), C.I. Direct Yellow 142 (b) and C.I. Reactive blue 21 (c)

Kinetic parameters were calculated using the most popular models such as pseudo-first order model, pseudo-second order model and intaparticle difussion model.

Citric acid as a natural complexing agent in the rare earth elements recovery process

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Rare earth elements play a significant role in many fields of industry. They are used in the production of lasers, LCD and plasma screens as well as catalysts and magnets, in the electric hybrid vehicles as well as in batteries. Due to their extensive application, it is important to develop a recovery process. One of the most effective methods of rare earth elements recovery is ion exchange. In this process the complexing agents such as ethylenediaminetetraacetic (EDTA) and nitrilotriacetic (NTA) acids are used. However, they are characterized by poor biodegradability. Therefore, biodegradable complexing agents that increase the efficiency of the rare earths recovery process should be searched for. Citric acid is a common, natural organic acid, known for its ability to form various types of complexes with metal ions. Citric acid can be proposed as an alternative chelating agent for synthetic compounds, having the advantage of low price, safety, non-toxicity and high biodegradability. The aim of this study was to determine the sorption capacity of selected adsorbents as regards the representatives of rare earth elements in the presence of citric acid. The effects of initial solution pH, REE(III):citric acid molar ratio, contact time, initial concentration and temperature were studied using the batch technique. The kinetic parameters were determined using the pseudo-first order (PFO), pseudo-second order (PSO) and intraparticle diffusion models. The equations of Langmuir, Freundlich and Temkin isotherms were applied to determine the isotherm parameters. The desorption studies were also carried out to evaluate the regeneration abilities of the adsorbents.

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Environmental assessment in the area of impact of the hosiery factory through the study of snow cover

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Analysis of the quality of the snow cover allows tracing the spread of pollutants and receive a reliable picture of the zones of influence of industrial facilities.

A research of the snow cover was conducted in the area of impact of the hosiery factory (Grodno, Belarus) in this work in 2019–2020. Samples were taken in areas with intact snow cover on 8 sample plots with an area of 1 m^2. Some organoleptic, physicochemical properties were determined in the samples and biotested using *Raphanus oliefera* and *Lepidium sativum* (parameters – germination, germination energy, length and weight of seedlings).

The results of the study showed that all selected snow samples contained suspended solids, had a slightly yellow color, a characteristic odor with varying intensity and turbidity. Most of the samples had a slightly acidic environment. The most informative indicators for the biotesting of the snow cover were the average length of the root and seedling of *Raphanus oliefera* and *Lepidium sativum*. These indicators decreased on test plots to 15–20% of the control. The rest of the parameters did not reveal a significant difference. According to the data obtained, it can be concluded that a sample taken on the territory of joint exposure of the factory and vehicle emissions is the most toxic for the studied test cultures. Moreover, its negative impact on the scrutiny indicators was recorded at once by two studied plants.

The biotesting of the snow cover in the area of exposure to emissions from the hosiery factory showed a weak toxicity of the environment (reduction to control - up to 80%).

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