NATURAL SCIENCE
BALTIC CONFERENCE

20-21.04.2024

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Information about The Natural Science Baltic Conference

The international "Natural Science Baltic Conference" (NSBC) took place, continuing the tradition of the popular Baltic Chemistry Conference. NSBC is a free international conference aimed at students and postgraduates, designed to enhance the scientific potential of young scientists. The event was completely free for both speakers and passive participants, attracting numerous attendees from various countries.

A total of 147 participants joined us, presenting 89 talks and posters, representing 28 different research institutions from 7 countries. This incredible outcome truly showcases the strength of our scientific community. We sincerely thank everyone for their participation and look forward to future gatherings that inspire further research.

Due to its interdisciplinary nature, the NSBC was divided into three thematic panels:

- CHEM PANEL: This panel featured research in the fields of chemical sciences, environmental sciences, ecology, and nanotechnology.
- BIO PANEL: This panel focused on biological sciences and biotechnology.
- PHYS PANEL: This panel covered topics in physical and mathematical sciences.

During the conference, young scientists, including students, doctoral candidates, and early-career researchers, had the opportunity to present their research findings and discuss popular science topics. Their presentations and posters were evaluated by members of the Scientific Committee, who selected the best ones.

NSBC was held exclusively online, enabling broad international participation without geographical limitations. The conference was a significant success, highlighting the growing importance of international collaboration and an interdisciplinary approach in the advancement of science.

We extend our heartfelt congratulations to all participants and award winners and thank everyone for their involvement in this year's edition of the Natural Science Baltic Conference.

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Special Guests

Dr. Manuel Banzhaf

University of Newcastle
20.04.2024

„Using systems microbiology to combat infectious disease"

At this research seminar I will present how we can use arrayed and pooled bacterial libraries to systematically dissect complex bacterial processes such as antimicrobial resistance or the bacterial cell envelope biogenesis. The first part of the talk will be very conceptual explaining you the basis of chemical genomics and other phenotyping approaches we routinely employ in the Banzhaf lab with the goal to showcase how those methods may help you to answer your specific research questions. In the second part of my talk I will present what we learned from profiling two P. aeruginosa single-gene deletion libraries (in the clinically relevant strains, PA01 and PA14) in over 200 chemical and environmental stresses and how we currently expand this platform to other single deletion libraries of bacterial pathogens (K. pneumoniae, Vibrio cholerae, Mycobacterium bovis BCG, etc.) and libraries of sequenced clinical isolates.

Dr. Joanna Drzeżdżon

University of Gdańsk
21.04.2024

„Self-healing polymers – synthesis, application and future research directions"

Among polymer materials, a remarkable group consists of self-healing polymers. These are materials with the ability to regenerate after mechanical damage or other types of injuries. Self-healing polymers are innovative materials in the market, which are mostly still in the research phase. They are materials capable of repairing minor damages autonomously, without the need for external intervention. Self-healing polymers find applications in various fields such as automotive industry, medicine, aviation, electronics, chemical industry, construction, and others.

Presentations

Experiments on the Demography of The Nine-Spotted Moth (*Amata phegea*) in Bükk National Park

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Abstract:

Amata phegea, commonly known as the 'nine-spotted moth,' is a prominent Erebidae species widely distributed in Europe. Recognized by its distinctive blue-black or green-black wings adorned with white spots and a metallic sheen, *A. phegea* plays essential ecological roles as a polyphagous moth and an effective pollinator. Despite its ecological significance, there is still limited published studies on its demography, especially in natural conditions. This research addresses this gap by conducting a mark-release-recapture method in Bükk National Park, Hungary. Over four days, 125 moths were marked and tracked across three distinct areas. The best-performing model indicates a constant survival rate (Phi) of 0.75. The overall detection probability (p) of 0.67 is influenced by time, with the second day exhibiting the highest frequency of captures and recaptures. The recruiting rate(pent) of 0.22 per day is influenced by sex, where male moths are being captured and recaptured more than female moths. *A. phegea* show a very restricted home-range in Area 1, significantly different from Area 2 (ANOVA P<2e-16) and Area 3 (P=3.7e-15). There are also very noticeable differences between male and female movements, where male moths are seen to be more active than females (Chi-square test: X^2 = 142.44, P = < 2.2e-16). Fundamental studies such as this is also very important, as if from this the ecological role of *A. phegea* known to be very important, this study can serve as a basis for future conservation policy-making.

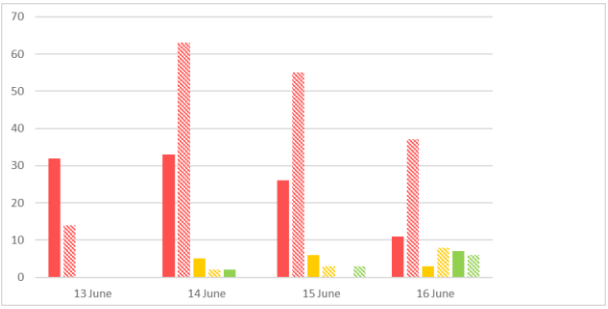

Fig. 1. Comparison between capture and recapture events during four days observation period accross the three area. Filled box indicates capture events and dashed fill box indicates recapture events. The data reveals a notable concentration of capture and recapture events in area 1. Particularly, on the second day of observation, recapture events peak, gradually declining in the subsequent days.

The author is deeply grateful to Dr. Bán Miklós and Dr. Ádám Lendvai for their support, guidance during the observation, and their substantial contributions to this paper. I also thank the University of Debrecen for supporting this field research.

Literature:

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Deep eutectic solvents as alternative additives to increase CO_2/N_2selectivity in PES/SAPO-34 mixed matrix membranes

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Abstract:

The SAPO-34 appears as one of the main materials in mixed matrix membranes for gas separation because of its pore size (0.38nm) is near the kinetic diameter of gases like H_2 (0.29nm), CO_2 (0.33nm), N_2 (0.36nm), CO (0.37nm) and CH_4 (0.38nm). Although PSA, TSA and cryogenic distillation are mostly used industrially in CO_2 separation, the use of MMM with zeolites and other silicate derivatives in gas separation provides lower energy consumption, is modulable and can be connected to traditional processes, besides showing permeability and selectivity above the Robeson upper limit [1]. The surface functionalization of inorganic solids arises to improve the zeolite-polymer matrix interaction. Deep eutectic solvents are proposed to improve the interaction between those components, increasing the membrane separation performance while replacing ionic liquids as an environmentally friend alternative [2,3].

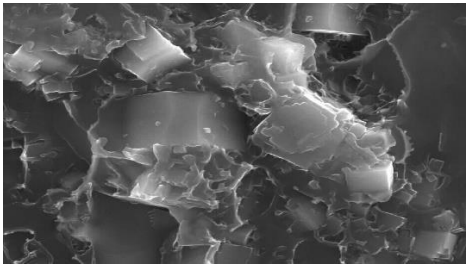

Fig. 1. PES/SAPO-34 mixed matrix membrane particle zoom.

The authors gratefully acknowledge the financial support of the FCT through the PhD grant (SFRH/BD/148170/2019).

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Microwave synthesis of new anilinotriazine derivatives with potential biological activity

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Abstract:

Triple negative breast cancer (TNBC) is a form of cancer where the lack of expression of the estrogen hormone receptor (ER), progesterone receptor (PR), and HER2 receptor renders standard therapies ineffective. Research on 1,3,5-triazine derivatives suggests their anticancer potential in TNBC, which may be crucial in combating this aggressive form of breast cancer. [1],[2]

Microwave synthesis of 1,3,5-triazine derivatives functionalized with morpholine was used to shorten the reaction time and save electricity. Test reactions with 2-phenylethylamine were performed using various microwave synthesis conditions. The selected optimal conditions allowed the synthesis of three new connections, previously undescribed in the literature. One of these compounds was subjected to cytotoxicity tests on TNBC cell lines and a control line, as well as an in silico ADME-Tox assessment.

The optimal conditions for microwave synthesis are the use of Na_2CO_3 as a basic agent, TBAB as a phase transfer catalyst and DMF as a solvent. The selected compound exhibits weak or moderate cytotoxic activity against TNBC cell lines, with the lowest IC_{50} value of almost 60 μM for the MDA-MB231 line. It does not show toxicity towards the MCF-10A control line, which is important for targeted therapy. Despite their weak effects, a group of compounds may potentially have anticancer effects, requiring further research.

The synthesis conditions used allowed obtaining products with high or medium efficiency (>50%). The obtained 1,3,5-triazine analogues are new compounds, not yet described in the literature. The selected compound has weak or moderate cytotoxic activity against TNBC cell lines, but is not toxic to the MCF-10A control line, which is important for targeted therapy.

Literature:

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Cationic lignin derivatives as natural ingredients for hair conditioners

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Abstract:

The use of cosmetic products is a highly popular practice. However, the increasing use of these products has raised concerns about their environmental impact. For example, some compounds commonly found in hair care formulations, such as cationic conditioning agents, are reported to be toxic to aquatic organisms[1]. The rinsing of hair care products results in their entry into wastewater systems, and, eventually, their discharge into rivers and oceans. These problems, and the increasing preference for natural products with low environmental impact, have motivated the research on renewable feedstocks for the development of cosmetic formulations[2]. Biopolymers, such as lignin, are excellent candidates to be used in bio-based formulations. Lignin is a natural polyphenol that has been reported as a multi-functional cosmetic ingredient for hair care, offering antibacterial, antioxidant, and sun-protective activities[2]. Lignin's hydrophobic nature can help to restore the hydrophobic barrier characteristic of healthy hair, and the presence of its functional groups allows for chemical modifications, namely by introducing cationic groups, which will enhance the interactions with hair. In this work, lignin extracted from Acacia wood was chemically modified to prepare cationic derivatives that could act as hair conditioning agents. The effect of the cationization conditions (ratio lignin/cationizing agent and temperature) on the degree of substitution and on the surface charge of the prepared polymer were evaluated. The new lignin-based conditioning agents should be able to efficiently repair damaged hair and not compromise the environment or the consumers' health.

This work was financially supported by the Portuguese Foundation for Science and Technology, FCT, via the projects 2022.06810.PTDC, UIDB/05183/2020, and UIDB/00102/2020, and the researcher grants CEECIND/01014/2018 and 2021.00399.CEECIND. C. Fernandes also acknowledges FCT for the PhD grant (2021.05991.BD).

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Exploring the Potential of Vancomycin-Loaded Hydrogel-Based Systemsin Antibiotic Therapy

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Abstract:

Vancomycin (VAN) is a versatile antibiotic effective against a wide range of infectionscaused by Gram-positive bacteria. It is often prescribed for severe infections and is particularly useful in treating patients undergoing neurosurgery.[1] When tissue is infected,the antibiotic administration is required and the main challenge then is to reach the targeted site with a pharmaceutical agent, which is difficult to achieve in conventional therapies.

To address this issue, we have developed the innovative hydrogel-based composites for the local vancomycin (VAN) therapy. Proposed systems are composed of VAN-loaded-chitosan-based particles embedded into biomimetic collagen/chitosan/hyaluronic acid-based hydrogels chemically crosslinked.

It is anticipated that this designed system will facilitate the targeted delivery of the active substance to the affected area, thereby minimizing systemic toxicity and ensuring controlled or sustained release.

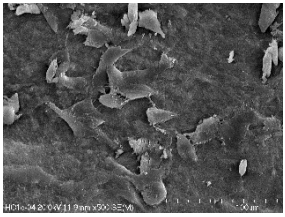

Fig. 1. SEM microphotographs of MG-63 cells cultured on prepared hydrogels.

Acknowledgements: The Authors acknowledge the financial support of the National Science Centre, Poland, grant OPUS 21, No UMO – 2021/41/B/NZ7/03816

Literature:

[1] Paul R. Krafft, Corin P. Agoris, et al., 2022. Topical vancomycin reduces surgical site infections in patients subjected to craniotomy for primary brain tumor resection: A comprehensive cancer center experience, Clinical Neurology and Neurosurgery 215, 107206

Exposure to potentially toxic metals through ingestion of Arabica and Robusta coffee infusions prepared in aluminum and steel moka pots

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Abstract:

Coffee is considered one of the most popular and valuable agricultural products nowadays. Its crops are cultivated in tropical and subtropical areas located in America, Africa, Asia and Oceania [1]. Due to its properties and composition, various applications of coffee have been discovered over the years. It is primarily used as a hot beverage as well as a food additive, because of its unique flavor and high caffeine content, but its composition depends highly on a variety of coffee beans, postharvest processing, roasting degree and brewing methods [2]. Therefore, the purpose of this study was to compare the content of trace elements such as nickel, chromium and aluminum in the beans and infusions of Arabica and Robusta coffees, depending on their origin and brewing method.

The results obtained for coffee beans show considerably lower concentrations of Ni and Cr than Al in all samples. Ni was found up to 3.9 μg g^{-1} and Cr only up to 1.6 μg g^{-1}, whileAl was determined up to 72 μg g^{-1}. In roasted coffee, the concentration of nickel was considerably lower than in green beans. That decrease was not observed for chromium andaluminum.

The highest concentration values obtained during the tests with steel moka pot were 10 μg L^{-1} for Cr and 77 μg L^{-1} for Ni. With an average consumption of 3 cups of coffee per day brewed in a steel moka pot used in this study, the average person will be exposed to an average daily dose of $4.75 \cdot 10^{-5}$ and $3.23 \cdot 10^{-4}$ mg kg^{-1} day^{-1} of chromium and nickel, respectively. On the other hand, brewing coffee in an aluminum moka pot results in a concentration of aluminum up to more than 1 mg L^{-1}, so the migration of this element is significantly higher than that of chromium and nickel. Such a concentration will result in an average daily dose of $5.36 \cdot 10^{-3}$ mg kg^{-1} day^{-1}. This concentration, however, is still safe for consumers.

This research was supported by the Polish Ministry of Science and Higher Education.

Literature:

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Nanocarriers Based on Chondroitin Sulfate Nanocapsules for Delivery of Drugs and Nutraceuticals

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Abstract:

Nanoemulsions based on oil-core nanocapsules (NCs), are capable of being effective transport various lipophilic bioactives.[1] This study focused on the preparation and characterization of NCs comprising chondroitin sulfate (CS)-based shells and liquid oil cores. To accomplish this, two hydrophobic derivatives of CS were synthesized by attaching octadecyl or oleyl chains and then the CS-based NCs were created by emulsifying triglyceride oil within a dispersion of hydrophobically modified CSs using sonication.

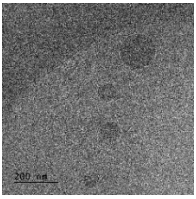

Fig. 1. Cryo-TEM micrographs of CS-based NCs.

Using dynamic light scattering (DLS) and cryo-transmission electron microscopy (cryo-TEM) methods it was possible to determine the sizes (20-500 nm) and spherical shape of core-shell nanoparticles. The cytotoxicity of CS hydrophobic derivatives and CS-based NCs was assessed using human keratinocytes (HaCaT) and primary human skin fibroblasts (HSF). This allowed to demonstrate that the use of hydrophobic polymer derivatives as coatings of oil-core nanocapsules reduced cytotoxicity of CS derivatives. CS-based NCs showed effective encapsulation of hydrophobic compounds, suggesting their potential as carriers for lipophilic bioactives.

This work was supported by the National Science Centre, Poland (grant no. 2019/35/B/ST5/02147).

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Health-promoting behavior in people struggling with type II diabetes

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Abstract:

The main goal of the work is to check the lifestyle of people struggling with insulin resistance and type II diabetes and to analyze people's awareness of the topic developing diabetes. 215 people from diabetes community groups were surveyed insulin resistance in the age group 21-81 years. It was used as a research tool own questionnaire. It contained 26 closed questions and 9 questions open. There was an inclusion and exclusion criterion for the survey. 61% of surveyed people engage in physical activity in their everyday life. 39% surveyed people avoid physical activity in everyday life. The most frequently performed one marching turned out to be a form of movement. Dancing was the least popular. 76% of people respondents had their blood sugar tested within the last year.

Most respondents support physical activity on a daily basis. Almost half of the surveyed people assess their health condition as average. Occurrence decreased LDL cholesterol or increased triglycerides occurred mainly in people with sporadic physical activity.

More than half of the respondents has struggled with a diabetic pregnancy in the past and is currently suffering from type II diabetes. [1,2].

Fig. 1. Diabetes receptors

Literature:

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Microgel anchored on a conductive surface as a controlled release system

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Abstract:

Microgels are three-dimensional cross-linked polymers filled with the solvent. Some of them could be include into "smart" materials group through the ability to significantly change their properties in a response to external stimulus. To the most widely studied those sensitive to changes in temperature and pH are involved. However, recently the studies on electroresponsive hydrogels are growing interest [1].

In this project microgel based on polyacrylic acid and electroactive ferrocene was synthesized. The obtained material was used to modify the gold electrode surface through the chemisorption process. The presence of ionized carboxyl groups was used to the introduction of a positively charged active substance into the microgel polymer network through the electrostatic interactions. Oxidation of ferrocene groups, as a result of applying an appropriate potential, led to the positive charge generation in the polymer network. The appearance of competitive electrostatic interactions caused the model molecules release to the environment. The obtained system could be used in the electrochemically controlled advanced releasing system construction.

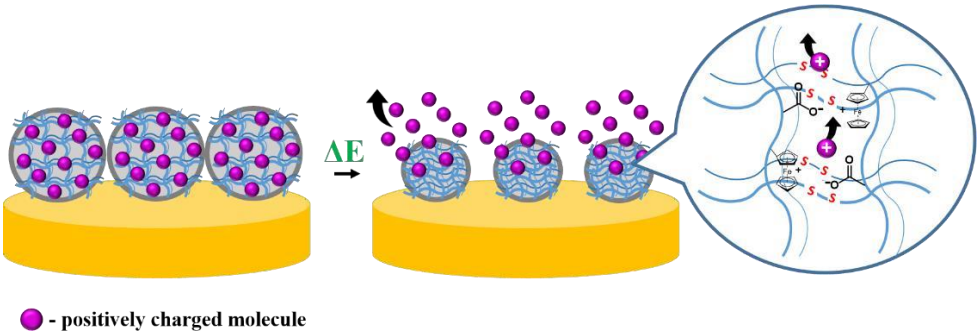

Fig. 1. Scheme of electrochemically induced release of a model substance from a microgel monolayer on the electrode surface.

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Polyphosphate granules serve as an alternative scaffold for Lon protease during stress conditions.

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Abstract:

Compartmentalization is essential for fundamental cellular processes in both eukaryotic and prokaryotic cells. This spatial segregation is facilitated by membrane organelles as well as membrane-less organelles (MLOs). In bacteria, in response to stress such as amino acid starvation or oxidative stress, inorganic polyphosphate (polyP) is synthesized. PolyP chains form granules in the cytoplasm, which are considered as MLOs. The structure and function of those organelles are not fully understood and elucidated.

Lon protease, which is found in nearly all organisms is typically associated with the nucleoid. We found that in starved *E. coli* cells, Lon protein degrades the replication initiation protein DnaA, and this degradation depends on polyP. Our *in vitro* results showed that this reaction is dependent on the phosphorylation status of DnaA and the interaction of both DnaA and Lon proteins with polyP. Degradation of DnaA protein during stress is crucial for the arrest of DNA replication initiation [1].

To analyze the intracellular localization and dynamics of Lon protease with respect to growth conditions and Lon association with nucleoid and polyP, we engineered and obtained *E. coli* strains with fluorescently labeled Lon protein variants, which expression is controlled by its native promoter. Real-time analysis of single cells using fluorescence microscopy combined with a microfluidic system revealed that the intracellular localization of Lon protein with nucleoid is highly dynamic. When stress is applied, Lon undergoes clustering and is colocalized with polyP granules. These results, combined with our previous *in vitro* findings, support our hypothesis that polyP granules serve as an alternative scaffold for the Lon protease changing its intracellular localization and activity.

These results highlight the role of polyP granules formation in the intracellular phase separation in *E. coli*. PolyP granules act as MLOs, providing compartmentalization for proteins that are crucial during stress recovery and survival.

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Magnetite/polynorepinephrine/cholesterol oxidase as a hybrid material for biosensor applications

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Abstract:

The aim of the conducted research was to obtain a core-shell hybrid nanomaterial, with a metallic core and a biomimetic shell, which served as a carrier for enzyme immobilization. For this purpose, magnetite was obtained by co-precipitation method, and then coated with norepinephrine hydrochloride (NE·HCl) through polymerization. Subsequently, physicochemical analyses of the composite were performed, and it was applied as a matrix for the immobilization of cholesterol oxidase, which was then coated with a layer of Nafion®. The biosensor constructed for cholesterol measurement was subjected to basic electrochemical studies aimed at evaluating its performance.

A detailed analysis of the research conducted on the biosensor constructed within the study allows the formulation that it stands out for its high sensitivity, selectivity, stability, and linearity, making it a promising alternative for measuring cholesterol levels in the blood [1-3].

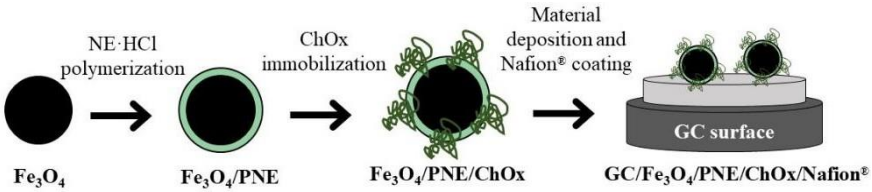

Fig. 1. Schematically presented stages of receiving the GC/Fe_3O_4/PNE/ChOx/Nafion® biosensor

The research work was financed and prepared as part of the Poznań University of Technology research project no. 0912/SBAD/2411.

Literature:

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In vivo and in vitro studies of efficient mephedrone adsorption over zirconium-based metal-organic frameworks corroborated by DFT+D modeling

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Abstract:

Currently, the synthetic cathinone group is the most widely used and commonly overdosed drug by youth. Mephedrone (4-MMC), an inexpensive, readily available drug that mimics the pharmacological effects of amphetamines, is their representative. Number of people addicted to mephedrone is steadily increasing year after year [1]. Among the known adsorbents, none effectively adsorb 4-MMC both from water, as a means of treatment, and from the human body in an overdose situation. Metal-organic frameworks (MOFs) as an innovative group of porous materials with high specific surface areas seem to be suitable. They are characterized by high stability, biocompatibility and low toxicity. Our study focused on determining the sorption kinetics of 4-MMC using MOFs: UiO-66, UiO-66_25%HCL and NU-1000, but also extensive spectroscopic characterization including FTIR, μRaman, 1 H NMR, UV-Vis, and DFT was demonstrated. Moreover, *in vivo* and *in vitro* experiments proved that MOFs are potentially safe for living organisms and have cardioprotective properties.

The work was supported by the National Science Centre, Poland, under the research project "MOF-antidote": Novel detoxification materials based on metal-organic frameworks for drugs of abuse removal – synthesis, chemical characterization, toxicity and efficacy in vivo and in vitro studies", no. UMO-2021/43/B/NZ7/00827.

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Bacterial-derived polymer poly-γ-glutamic acid (γ-PGA) - the key to survival of flowers of yellow lupine under drought stress?

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Abstract:
Drought is a global issue that indirectly and directly affects the overall human population. Water deficit in various regions of our globe have a detrimental impact on the cultivation of many crops such as legumes. Among them, yellow lupine (*Lupinus luteus* L.) – an agriculturally important species is characterized by a high correlation between drought and yielding. This stress factor leads to premature and excessive abortion of flowers, which reduces the number of seeds developed by the particular plant [1]. The process of flower abscission occurs in a specific place named the abscission zone (AZ) which is located at the base of the pedicel [2]. The activation of lupine flower AZ depends on the cell wall-related modifications associated with reorganization of particular components [3].
The first place of drought perception is root. It has been proven that rhizosphere microorganisms composition is strongly affected when the water content in soil decreases. These microorganisms can produce many plant protective substances that improve their growth, development, and help to survive unfavorable conditions [4]. One of these beneficial compounds is poly-γ-glutamic acid (γ-PGA) which is naturally synthesized by soil bacteria of the *Bacillus* genus [5]. Despite the knowledge about the way of action of this biopolymer on plants, its impact on AZ functioning is still uncovered. That is why, we tried to elucidate the influence of lupine treatment with synthetic γ-PGA on the structure of AZ subjected to drought with particular emphasis on the cell wall. During the course of the study, we have revealed that γ-PGA reversed the negative effect of drought stress on the cellular structure of flower AZ. Based on microscopy observations we decided to focus in further experiments on the comprehensive analysis of pectin. It was possible with specific antibodies to detect non- and low- (anti-JIM5), as well as high- methylated (anti-JIM7) homogalacturonans, galactans (LM5), and arabinans (LM6). It has been revealed that γ-PGA modifies the pectin composition and in this way might modulate the cell wall mechanical strength. The obtained results provide information about the promising effectiveness of γ-PGA in alleviating soil drought stress on plants which could be used in agrotechnical practices essential to maintain high crop yielding.

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Miniaturization of a glucose biosensor based on poly(caffeic acid) hybrid material

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Abstract:

Innovative biosensors employing hybrid materials offer unprecedented accuracy and sensitivity in glucose measurements. By harnessing the synergistic properties of novel materials, these biosensors provide a wide dynamic range and exceptional selectivity, ensuring reliable glucose detection in real samples like human serum or blood [1].

Herein, we introduce a novel biosensor with poly(caffeic acid) (PCA) grafted onto magnetite (Fe_3O_4) nanoparticles, inspired by nature, along with glucose oxidase (GOx) from *Aspergillus niger*, employing an adsorption technique. The biomolecular corona was employed in fabricating the biosensor system using screen printed electrode (SPE). Results indicate the system operates efficiently at a low potential (0.1 V).

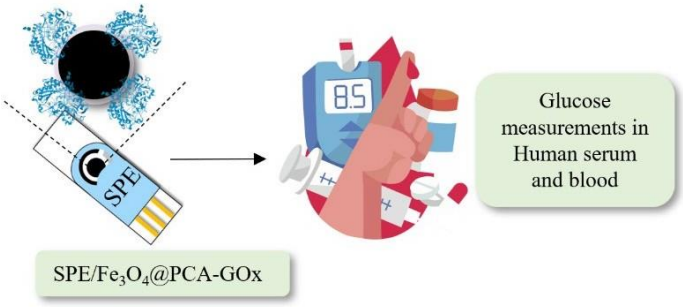

Fig. 1. Schematic representation of the conducted research

The work was financed and prepared by the Poznan University of Technology research grant no. 0912/SBAD/2411.

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Innovative method of juices sterilization with the use of cold atmospheric plasma

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Abstract:

Currently, there is a problem with food spoiling too quickly, which causes its excessive waste. In order to overcome this problem it is possible to apply a method for prolonging the shelf life of the products. An innovative solution for this purpose might be utilization of non-thermal plasmas. During non-thermal plasma operation Reactive Oxygen and Nitrogen Species (RONS) are produced. These RONS might putatively reduce the number of microorganisms naturally occurring in the analyzed juice.

The aim of this research was to check the possibility of using non-thermal plasma for eradication of microorganisms from freshly squeezed citrus juices (orange, mandarin and grapefruit). To reach this aim, pulse modulated radio frequency atmospheric pressure glow discharge (pm-rf-APGD) was used as a source of non-thermal plasma. In order to find optimal conditions for juice treatment, multivariate optimization of working parameters of the applied systems was performed. The analyzes conducted for non-thermal plasma-treated juices included pH and conductivity measurements, determination of saccharide content – Brix measurements, estimation of the concentration of ascorbic acid, and determination of the number of colony forming units of the microorganisms.

It was found that these studies give hope for the development of an effective functional juice production method in the future. Other plasma systems, including high-throughput ones, are being implemented for this purpose.

Acknowledgements: The studies were financed by National Science Centre (Poland), Opus 23 (2022/45/B/ST8/02410) research project, granted to prof. Anna Dzimitrowicz.

Development of phosphogypsum landfills as a way to reduce eutrophication of the Baltic Sea

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Abstract:

Phosphogypsum is the main waste from the superphosphates production – an artificial fertilizer, which is produced from phosphoric acid. Classified as the hazardous waste, which disposal is limited only to storage in landfills or submerged. Both options affect the pollution of seas, oceans and groundwaters [1]. This leads to excessive eutrophication of aquatic environments.

The greatest phosphogypsum landfill in Poland located in Police covers the area of over 270 ha. According to data from September 2022, there are currently nearly 100 million tonsod phosphogypsum [2].

The main goal of the project is to use phosphogypsum in an aluminosilicate composite. Previous research works have shown the potential of using this waste in the construction and road industry, after appropriate preparation of the material. Current research is considering the use of an alkaline activator that can significantly reduce the acidity of the material.

The use of various types of alkaline activators is being considered to neutralize the acidity of phosphogypsum and reduce the firing temperature of the ceramic materials, which will directly reduce CO_2 emissions during production and maintain the parameters required byconstruction materials.

Industrial use of this waste will reduce its negative impact on the environment and the lackof the need to store it will prevent it from entering into water reservoir.

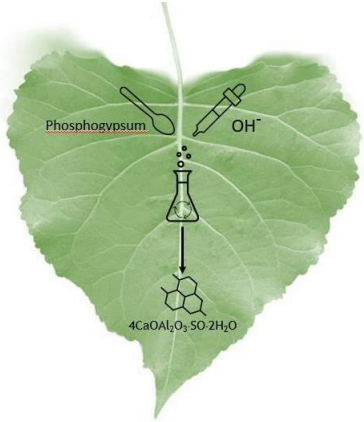

Fig. 1. Puzzolans formation in synthesis of phosphogypsum and alkali activator

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Design and synthesis of peptide conjugates toward antimicrobial activity

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Abstract:

In recent decades, there has been a remarkable escalation in the incidence of diseases attributed to pathogenic fungi, affecting a staggering population of more than one billion people worldwide. These diseases pose a significant threat not only to quality of life but also to overall health outcomes, manifesting in a spectrum ranging from superficial to systemic infections [1,2].

The current pharmaceutical landscape is characterized by the dominance of four major classes of antifungals: azoles, polyenes, echinocandins and fluorinated pyrimidines. Of these, the azole agents occupy a key position. However, increasing resistance to conventional antifungals, coupled with the proliferation of immunodeficiency syndromes and limited therapeutic options, underscores the need to explore novel treatment paradigms for fungalinfections [3, 4].

A particularly promising frontier in this endeavour is the design and synthesis of peptide conjugated azole compounds. Such conjugates involve the covalent coupling of molecules with different chemical architectures, often resulting in derivatives that are endowed with enhanced or diversified biological properties [5, 6]. Following this line of investigation, we designed and synthesized a series of compounds conjugating fluconazole via a hydroxylgroup to either an antimicrobial peptide or a cell-penetrating peptide. These synthesised conjugates were then subjected to antimicrobial profiling against selected strains of yeast as well as Gram-positive and Gram-negativebacteria.

The research was funded by BMN (No. 539-T060-B137-24)

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Characterisation of microplastics retained in corrosion deposits of drinking water pipes

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Abstract:

Corrosion deposits on the inner surfaces of metal water pipes are formed by electrochemical or biological processes. Their presence on the pipe walls results in a deterioration of the organoleptic parameters of the water, as they cause a metallic taste to the water and give it a reddish rusty colour. Corrosion deposits are characterised by their irregular structure, high porosity and undulations, which favour the retention and accumulation of solid and colloidal water admixtures, including microplastics (MP). Changes in water quality, hydraulic conditions in water pipes and their failures/renovations cause damage to the structure of desposits, resulting in the release of accumulated contaminants into the bulk water. It can therefore be assumed that corrosive sediments are one of the potential sources of microplastics in drinking water. The presence of MP in tap water is hazardous to human health due to its documented potential to accumulate in the body and its ability to adsorb and transport harmful compounds on its surface [1-3].

The aim of this study was to determine the degree of microplastic particle contamination of sediments deposited on the inner surface of metal alloy pipes taken from the distribution network of a large urban agglomeration, as well as to assess the isolated particles in terms of their origin and residence time in the water supply network. The pipes investigated were characterised by different diameters and different times of operation. Acquired sediments were dissolved with concentrated hydrochloric acid (Stanlab) and microplastic isolation was carried out by vacuum filtration on glass fibre filters (GF/D; Whatman). The filters were then washed with ultrapure water (Milipore) and dried in closed petri dishes. Isolated MP particles were analysed using a scanning electron microscope (SEM) with an EDS detector and Raman spectroscopy (i-Raman®Plus by BWTek).

The study showed that microplastics accumulate in the corrosion deposits. No significant correlation was found between the number of MP particles/kg of sludge and the time of pipe operation, indicating a constant and uniform exposure of corrosion sludge to microplastic particles transported by flowing water. More than 90% of the isolated microplastic particles were less than 50 mm in size, allowing them to be classified as the finest MP fraction or even nanoplastics (NP). Analysis of the elemental composition of MP showed that most of the identified microplastic particles were from common plastics such as polyethylene, polypropylene and polyethylene terephthalate.

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Innovations in Antimicrobial Hydrogel Development for Enhanced Wound Care

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Abstract:

Skin injuries resulting from trauma, burns, diabetes, genetic factors, or surgical procedures place a significant financial burden on healthcare systems [1]. It is projected that between 20 to 60 million individuals worldwide will be affected by chronic wounds by 2026 [2]. Among the primary obstacles associated with impaired wound healing is bacterial infection. When the skin's initial structural integrity is compromised due to cutaneous injury, it becomes a vulnerable entry point for microorganisms. As a result, every wound inherently becomes susceptible to bacterial infiltration, underscoring the importance of promptly initiating the healing process to restore skin integrity and mitigate the risk of infection. In the context of wound healing, microbial infections within wound beds present a significant challenge, necessitating the development of innovative therapeutic modalities. In our study, we aimed to engineer a novel antimicrobial hydrogel for infected wounds, integrating thermoresponsive properties and bioactive agents. Employing Box-Behnken Design methodology, our hydrogel formulation strategically combined a plant-derived extract rich in saponins and an antibiotic within a hyaluronic acid-infused matrix. The thermoresponsive nature of the hydrogel facilitated in situ gelation upon application to the wound site, ensuring sustained release of antimicrobial agents. By fostering an acidic wound environment, microbial proliferation is impeded, thus assumed to promote healing. Our study introduces a sophisticated therapeutic approach by addressing the critical need for effective antimicrobial interventions in wound care. Our innovative hydrogel holds the potential to revolutionize current treatment strategies and in the future, improve patient comfort in everyday life.

This work was supported by the NAWA INPUTDoc STER "Mobility" Programme.

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The impact of plant compounds with anti-cancer properties on liposomal doxorubicin in triple negative breast cancer oncological therapy

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Abstract:

The purpose of the research was to develop effective liposomal preparations containing liposomal doxorubicin (DOX) in combination with compounds of plant with anti-cancer properties. The obtained liposomal formulas were analyzed from the point of view of their effectiveness in triple negative breast cancer (TNBC) (1–3). Ultrasonic homogenization method was used to obtain liposomal systems containing DOX and one/two plant compounds. For measuring the size, the stability and degree of polydispersity of nanoparticles dynamic light scattering (DLS) was used. Fluorescence spectroscopy was used to analyze the DOX release profile from liposomes at different pH values. In order to determine the effectiveness of the obtained liposomal formulations, the two cell survival tests have been released - the MTT test (absorbance measurement) - 2D cell culture and the PrestoBlue test (fluorescence measurement) - 3D cell culture. A representative cell line of the most aggressive type of breast cancer – triple negative breast cancer (MDA-MB 231) was used to assess tumor cell survival (2). Confocal microscopy was used to determine the effect on the size of the spheroids (3D culture).

Based on the accomplished results, it was confirmed that the stable liposomal formulations with uniform population were obtained and their size would allow for using them as drug carriers. Liposomes with combination of doxorubicin and natural, plant compounds have shown enhanced cytotoxic efficacy against cancer cells, giving the possibility of their use in the treatment of triple negative breast cancer.

Literature

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Microplasma in analytical chemistry - miniature sources for elemental analysis

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Abstract:

Atomic spectrometers or mass spectrometers have been widely used to conduct elemental analysis of a variety of samples. Fast and field analysis is still limited by their large quantities, high power consumption, and complex operation. That way miniature system based on microplasma exhibits significant potential in elemental field analysis because of its affordability, small size, and low power consumption.

Microplasmas are low-temperature plasmas with microscale dimensions (<1mm), a distinct high-energy density, and a non-equilibrium reactive environment. These characteristics make them a viable material for engineering devices for a variety of uses [1].

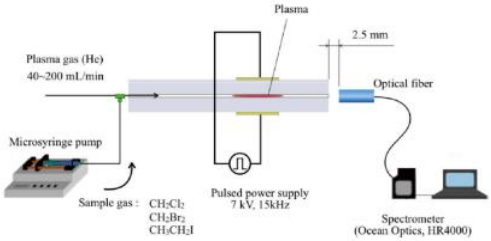

Fig. 1. Exemplary analytical system based on DBD microplasma for halogenated samples analysis [2].

The dielectric barrier discharge (DBD), glow discharge (GD), or atmospheric pressure plasma jets (APJs) were applied to generate a stable microplasma at atmospheric pressure. Such microplasmas applied in systems can allow to determination of organic and inorganic compounds.

In that way, the designed system shown in Fig.1 allowed to high-sensitivity analysis for small sample amounts by using a microplasma source.

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Selective cobalt recovery via electrodialysis

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Abstract:

In year 2023 cobalt was one of 34 critical raw materials according to the European Union. The extraction of cobalt is challenging, partly since most of its ores are located in the Democratic Republic of Congo. [1] It is, however, possible to effectively obtain it from scattered sources (e.g. industrial sewage) and waste materials (e.g. cathode materials of used batteries).

Electrodialysis (ED) is an electro-driven membrane technique that enables the removal and/or recovery of metal ions from low concentration solutions without the use of additional chemical agents. [2] In this work, the possibility of using a chelating cation exchange membrane for the selective recovery of cobalt (II) ions has been investigated. The feed material in the process was a model solution of leachate from the processing of used lithium-ion batteries containing lithium, cobalt, nickel and manganese ions. [3] Figure 1 presents the core principle of the discussed process. The obtained results, although not clinching, provethe high selectivity of the membrane in cobalt transportation and provides a promising basisfor further research.

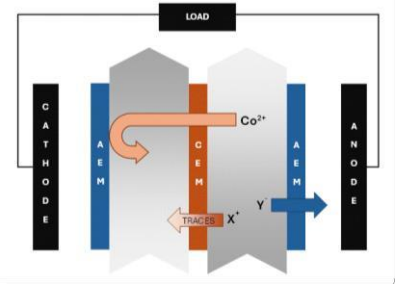

Fig. 1.Schematic representation of studied selective ED process

The author would like to thank Anna Siekierka PhD. for her supervision over the master's thesis, which is the basis for this presentation

Literature:

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Biodegradation of antifungal derivatives of imidazole and triazole by activated sludge

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Abstract:

Azole compounds are a class of emerging organic pollutants, widely used as antifungal drugs, fungicides and biocides due to their diversified biological activity. The extensive application of these substances results in their presence in surface water and wastewater treatment plants (WWTPs) [1]. The environmental contamination by azole fungicides is caused by their persistence in soil and water as well as their stability against hydrolytic, photolytic and biological degradation [2]. The objective of the study was to determine the removal efficiency of azole compounds in the biodegradation process using activated sludge as inoculum.

Biodegradation tests of azole compounds were performed with the use of activated sludge obtained from a municipal Wastewater Treatment Plant in Poznań and from a rural Wastewater Treatment Plant in Borówiec. The biodegradation efficiency was assessed using high-performance liquid chromatography coupled with tandem mass spectrometry (LC-MS/MS). To evaluate the metabolic activity of cells, as well as the toxicity of the tested compounds and the resulting products of degradation, an MTT assay was conducted. The biodegradation experiments were followed by the determination of azoles adsorbed on the activated sludge to exclude the removal by sorption.

The results indicate that almost complete degradation, above 90%, was obtained for climbazole and ketoconazole. The biodegradation curves show, that degradation occurred during the initial two weeks of the experiment, which coincides with the highest metabolic activity of the bacteria. However, in the case of other tested azoles, biodegradation is not a sufficient method of removing these compounds from wastewater and must be accompanied by other processes.

This work was supported by the Polish Ministry of Education and Science (0911/SBAD/2406).

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Sulforaphane Hormetic Effects in Triple Negative Breast Cancer: Insights from *In Vitro* and *In Vivo* Models

Anna Pogorzelska[1], Katarzyna Medyńska[2,3], Maciej Mazur[2], Marta Świtalska[4], Joanna Wietrzyk[4], Małgorzata Milczarek[1], Katarzyna Wiktorska[3]

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Abstract:

Our study aimed to assess the impact of dietary SFN doses on triple-negative breast cancer (TNBC) cell proliferation and migration using both *in vitro* and *in vivo* models. TNBC represents an aggressive phenotype with limited treatment options due to the absence of specific drug targets. Natural compounds are extensively studied for their potential to enhance cancer treatment efficacy. Among them, sulforaphane – a natural isothiocyanate, has been identified as a hormetic compound, exhibiting divergent effects: cytoprotective or cytotoxic depending on its concentration [1,2].

We utilized MDA-MB-231 cells *in vitro* and a murine TNBC model - 4T1 cell implants in Balb/c mice. Results of the *in vivo* experiment demonstrated up to 31% tumor growth inhibition after sulforaphane treatment, along with reduced cancer cell proliferation, necrotic areas, and altered immune cell infiltration, indicative of a less malignant tumor phenotype compared to the non-treated group. Additionally, sulforaphane treatment decreased the number of lung metastases. The *in vitro* study confirmed SFN's ability to inhibit cell migration, particularly in cells derived from 3D spheroids, rather than those in 2D *in vitro* cultures. These findings highlight the specific role of sulforaphane in TNBC primary tumor cells and their microenvironment.

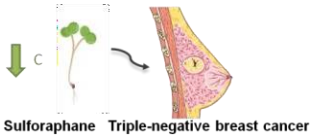

Fig. 1.Graphic diagram of the study.

The research was funded by the National Science Centre, Poland, 2021/41/N/NZ7/02530 and Ministry of Education and Science of the Republic of Poland (statutory activity of National Medicines Institute).

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Bioactive glass containing zinc ions as a carrier for 6-mercaptopurine

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Abstract:

6-mercaptopurine (6MP) faces a number of limitations related to its low bioavailability and short half-life [1]. To overcome its drawbacks, the carrier was synthesized. Bioactive glass is a biocompatible material widely used in tissue engineering to date [2]. Material doped with zinc ions shows potential in use as a drug delivery system. An important aspect was to check the presence and distribution of zinc ions on the surface of the material and in its pores. Thanks to these ions, the sorption process occurs efficiently due to the formation of coordination bonds between the sulfur atom, present in the structure of the drug, and the zinc ion. The even distribution of the zinc ions ensures regular dosing of 6-mercaptopurine from each volume of the carrier. To study the release profile, the process was monitored in an acidic environment designed to mimic the cancer environment and in neutral conditions, such as those found in human body fluids surrounding healthy cells. For acidic conditions, rapid release was achieved. In contrast, release at neutral pH takes much longer, minimizing the problem of the drug's short half-life. The research has confirmed the potential of the synthesized 6-mercaptopurine delivery system in the form of a bioactive glass doped with zinc ions. The carrier can be used in targeted anticancer therapy, providing enhanced therapeutic effect, comfort and patient safety.

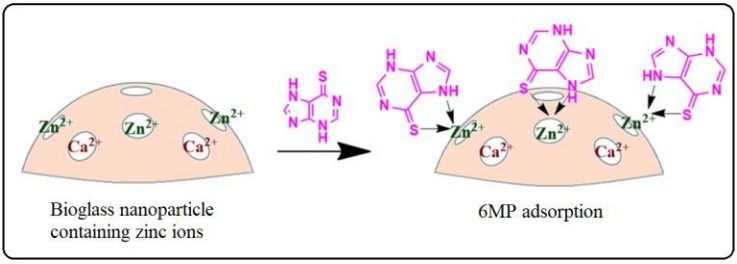

Fig. 1. 6-mercaptopurine sorption on bioactive glass doped with zinc ions.

This research was funded by the Ministry of Education and Science (Poland. no. 0912/SIGR/8059).

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The Nitrogen Content of Hycean Worlds

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Abstract:

Search for life outside Earth accelerated with discoveries of new exoplanets and the development of more precise telescopes. A recent detection of the exoplanet K2-18b sparked interest among scientists, when its atmosphere was characterized ([1] Madhusudhan et al. 2023) uncovering large amounts of carbon dioxide and methane in H_2-rich background. The planet is able to sustain liquid water, so there is a chance it could be habitable. In order to explore this idea further, we need to find more about other elements, which are the "chemical building blocks of life" - especially nitrogen. Molecular nitrogen (N_2) is not possible to detect, however we could potentially find its photochemistry products, such as hydrogen cyanide (HCN) and cyanoacetylene (HC_3N) ([2] Rimmer et al. 2021). So far there was no clear observation of any of these species, however we could set approximate limits on their concentrations from the received spectra.

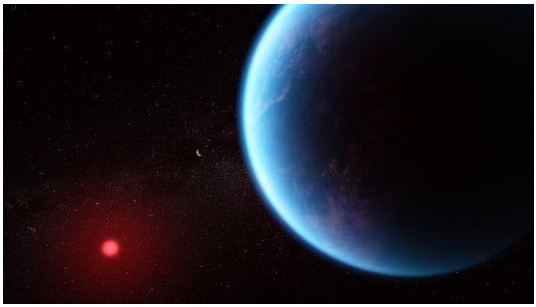

Figure 1: Artist impression of a hycean planet around M dwarf star.

The author is sincerely grateful to her supervisor Dr Paul Rimmer for guidance, advice and access to ARGO simulations and to Prof Nikku Madhusudhan for advice on interpreting the results.

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Titanium implant modified with zinc-doped carbon dots layer as an innovative coating for the development of local drug delivery system for ciprofloxacin

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Abstract:

Our research presents a new innovative drug delivery system for ciprofloxacin, which is based on the formation of a zinc-doped carbon dots layer on the surface of a titanium alloy (Ti6Al4V). In the paper, the effectiveness of the method of synthesis of a zinc-doped carbon dots layer was determined. The distribution of the layer of quantum dots on the surface of the titanium alloy was investigated using the FT-IR mapping technique. The effective synthesis of carbon dots and the coordination of zinc ions on their surface opens the possibility of sorption of ciprofloxacin, which results in a high application potential of the obtained biomaterial. The introduction of zinc cations on the surface of the quantum dots layer resulted in high sorption results of the active substance [1]. The release profile of ciprofloxacin from the modified surface of the titanium alloy indicates that this active substance can be released for up to 4 hours. The biomaterial obtained in this work is also hydrophilic, which was shown by the contact angle tests. The creation of such a layer on the titanium alloy and the possibility of coordinating the antibacterial drug on its surface may reduce the risk of infection during the implantation procedure [2].

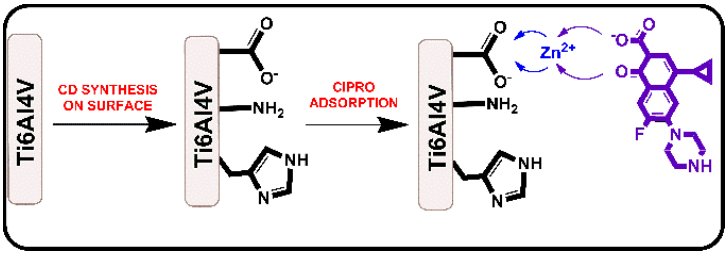

Fig. 1. Scheme of conducted modification.

This research was funded by the Ministry of Education and Science (Poland. no. 0912/SIGR/8059).

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Strategies for Boosting Proteolytic Resistance in Proteins

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Abstract:

Proteolytic resistance refers to the ability of a molecule, typically a protein or peptide, to withstand degradation by proteolytic enzymes. Proteolytic enzymes, also known as proteases or peptidases, are enzymes that cleave peptide bonds within proteins and peptides, leading to their breakdown into smaller fragments.

Proteolytic resistance is particularly important in the context of protein therapeutics, where maintaining the integrity and stability of the protein is crucial for its effectiveness and duration of action in the body. If a therapeutic protein is susceptible to proteolytic degradation,it may be rapidly broken down and cleared from the body before it can exert its desired therapeutic effect [1].

Various strategies can be employed to enhance proteolytic resistance in proteins and peptides. These include structural modifications to the molecule to protect vulnerable sites from protease cleavage, such as through the introduction of stabilizing mutations or chemicalmodifications. Additionally, formulation approaches may be employed to shield the molecule from proteases in the surrounding environment, such as encapsulation in nanoparticles or incorporation into hydrogels.

Improving proteolytic resistance is an important consideration in the design and development of protein-based therapeutics, as it can help prolong their stability and bioavailability, ultimately enhancing their therapeutic efficacy [2].

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The influence of low-frequency electromagnetic fields on the preconditioning of mesenchymal stem cells – perspectives for stem cell therapy

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Abstract:

Mesenchymal stem cells (MSCs) have great potential for use in stem cell therapy due to their ability to self-renew, differentiate, and also the secretion of many active biomolecules with immunomodulatory, pro-angiogenic, re-epithelializing and neurotrophic properties. Preconditioning of mesenchymal stem cells is increasingly being considered and may help increase the effectiveness of stem cell therapy. Biochemical and biophysical stimuli in the MSC microenvironment can direct cells towards differentiation or a different fate, including increasing the secretion of biomolecules with therapeutic potential [1].

One of the physical factors controlling cellular fate, that researchers are considering is a low-frequency electromagnetic field (LF-EMF) which is shown to have a positive effect on MSCs. The purpose of this study was to collect and discuss the effects of LF-EMF on MSC biology and its potential application in cellular therapy. Non-ionizing EMF can influence proliferation, cell cycle, differentiation, mitochondrial function, and trophic activity of MSCs [1,2,3].

The use of LF-EMF in MSCs preconditioning may be an effective approach to overcome the limitations of MSCs therapy such as difficulties in cell adaptation and survival after administration to the patient as well as modulation of stem cell fate without additional factors and costs. However, it is crucial to adjust the EMF parameters and stimulation timein such a way that they demonstrate the maximum therapeutic effect while minimizing side effects, and for this purpose, understanding the mechanism of action of EMF on MSCs is very important for improving this outcome and the use of EMF in regenerative medicine [1].

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Application of Chromatographic and Thermal Methods to Study Fatty Acids Composition, Positional Distribution and Melting Profile as Important Factors Characterizing Pomegranate Seeds Oil

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Abstract:

In line with Europe's closed-loop policy, sustainable development goals, and the idea of "zero" or "less" waste, proper waste management is one of the main challenges facing the food industry [1]. Fruit processing by-products can be a source of nutrients and bioactive components that, once isolated, can be utilized. An example of their use is the extraction of oil from fruit seeds, which should meet certain requirements to be approved for human consumption [2]. The aim of the study was to assess the quality of pomegranate seeds oil using the followings parameters: the fatty acids profile by gas chromatography (GC); fatty acids distribution between *sn*-2 and *sn*-1,3 triacylglycerols (TAG) positions using enzymatic hydrolysis; oxidative stability by differential pressure scanning calorimetry (PDSC) and melting profiles by differential scanning calorimetry (DSC). The peroxide and acid values were also determined for extracted oil. Pomegranate seed oil has been shown to have a high content of conjugated linolenic acids (CLnA), which account for 65-80% of total fatty acids. The most important of these is punicic acid, which is characteristic of pomegranate seed oil. Saturated fatty acids in the tested oil preferred the *sn*-1,3 position in triacylglycerols. The oil's DSC melting curves were characterized by two endothermic peaks. The first peak of the low melting triacylglycerol fraction, dominated by polyunsaturated fatty acids, was in the temperature range from -80°C to -40°C with a maximum at -72.36°C. The second peak corresponded to the high melting TAG fraction, dominated by monounsaturated fatty acids. It was present in the temperature range from -73°C to -31°C with a maximum at -30.64°C. The acid value (AV= 2.72 KOH/g) of the tested oil was in accordance with the requirements of the Codex Alimentarius. Peroxide value (PV=6,34 meq O_2/kg) of pomegranate seed oil was in accordance with the requirements of PN-EN ISO 3960:2012 [3] and Codex Alimentarius.

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Challenges in the synthesis of non-centrosymmetric Ln-MOFs

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Abstract:

It has been reported that non-centrosymmetric lanthanide metal-organic frameworks (Ln-MOFs) can be successfully utilized as luminescence thermometers. Currently, the spectroscopic properties of Ln-MOFs, constructed from Er^{3+} doped with Yb^{3+} as nodes and formate as a linker, are known. These thermometers indicate temperature indirectly as a function of the ratio of luminescence intensity to second harmonic generation (SHG) intensity – a non-linear optical phenomenon in which two low-frequency photons are converted into a single photon with doubled frequency [1].

As another promising material for further studies on luminescence thermometers exhibiting SHG, an Ln-MOF built from Er^{3+} and trimesic acid was selected. The new linker is significantly larger, potentially enabling improvements in optical properties through linker functionalization.

During the presentation, the progress of the research will be discussed, along with the encountered challenges, shedding light on important aspects of MOF synthesis.

This work has been generously supported by the National Science Center, Poland through the Sonata grant no. 2020/39/D/ST4/01182.

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Ultrasonic synthesis of new benzyltriazine derivatives with potential biological activity

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Abstract:

Colorectal cancer is classified as a deadly disease, with more than 1.9 million new cases and 930,000 deaths worldwide in 2020. [1] Triazine analogs are used as therapeutic agents [2], due to their potent antiviral [3], antimicrobial [4], antimalarial, anticancer [5] effects. Triazines are also characterized by their ability to absorb a broad spectrum of UV radiation (UVA and UVB), antioxidant activity, and thermostability. [6]

The first stage of the study involved the synthesis reaction of N-benzyl-4,6-dichloro-1,3,5-triazin-2-amine (1), with N,N-diisopropylamine and tetrahydrofuran as the solvent. The synthesis of N^2-benzyl-6-chloro-1,3,5-triazin-2,4-diamine (2) was carried out with the addition of ammonia water and tetrahydrofuran was also used as a solvent. The resulting product served as a substrate for the next, final stage of the study. The final stage of the research involved a series of six test reactions to find the appropriate synthesis conditions, i.e. the choice of base and solvent and the invariable catalyst was TBAB. The reactions were carried out using an ultrasonic reactor for 5 minutes.

The reactions were carried out using ultrasonic waves, which significantly increase the speed of the reaction, saving energy and time and the synthesis was carried out in just a few minutes. In addition, minimizing the use of energy and solvents, makes the procedure compatible with the concept of "green chemistry." The best base for reactions carried out in water is NaOH at 79.4%, and for reactions carried out in DMF is Na_2CO_3 at 88.5%.

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Human 20S proteasome activators in the fight against neurodegenerative diseases

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Abstract:

Neurodegenerative diseases such as Alzheimer's disease (AD), Parkinson's disease (PD) are an extremely serious and growing social problem. In healthy cells, abnormal proteins are degraded by proteolytic systems, mainly the 20S proteasome. This huge enzyme complex is responsible for removing, misfolded and mutated proteins from cells. During aging, the effectiveness of the proteasome system gradually decreases, which leads to the accumulation of abnormal proteins and their aggregation. Unfortunately, with age, the effectiveness of the proteasome weakens. A promising therapeutic strategy to avoid or reduce this could be proteasome activation using synthetic compounds.

Potential therapeutics must be effective, capable of penetrating the cell membrane barrier, and resistant to enzymatic degradation. Compounds with such characteristics could restore proteostasis in patients suffering from age-related diseases. Currently, there are no drugs that can combat the causes of these diseases.

We synthesized peptidomimetic compounds, which were designed by introducing various modifications to the base sequence: a 14-amino acid peptide containing the C-terminal fragment of the natural proteasome activator, the Blm10 protein. We verified the effect of the the modulators‘ ability to activate both the 20S proteasome isolated from human erythrocytes and being a component of the HEK293T cell lysate. The most effective modulators stimulated the proteasome up to 18 times. Stability studies of the compounds in human plasma were also carried out. Through the introduction the cell-penetrating moiety (CPP) to their sequences activators are capable of penetrating cell membranes. Using the PAMPA we verified the ability of activators to cross the blood-brain barrier.

Peptidomimetics are able to improve the ability of the 20S proteasome to degrade model proteins in neurodegenerative diseases such as tau protein (AD) and α-synuclein (PD). As part of cooperation with the University of Helsinki, we tested selected compounds in an embryonic mouse cell model. All tested activators reduced the amount of the PD-related protein, α-synuclein, in hippocampal cells.

Acknowledgments: This study was financially supported by the NCN-funded grant 2019/35/O/NZ7/00227.

Hydrosilylation of C≡C triple bonds

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Abstract:

The hydrosilylation reaction is an addition reaction of organic and inorganic silicon hydrides to multiple bonds, in particular carbon-carbon, carbon-heteroatom and heteroatom-heteroatom bonds. For the first time as a reaction between trichlorosilane and 1-octene in the presence of acetyl peroxide was documented in 1947 by L.H. Sommer [1], which initiated research into this type of reaction and the Chalk-Harrod hydrosilylation mechanism was soon developed [2].

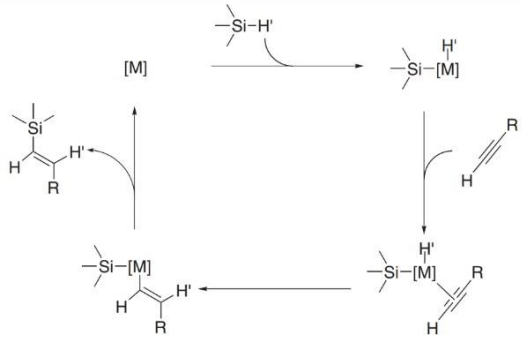

Fig. 1. Chalk-Harrod mechanism.

In the case of carbon-carbon triple bonds, the hydrosilylation process is an efficient method for the synthesis of small- and large-molecule organosilicon compounds, as well as stereo-defined organic derivatives, which are used as synthetic building blocks or key intermediates in the synthesis of natural products. In the scientific literature, we can find information on many types of catalysts used for this process, including homo- and heterogeneous Ru, Ni, Rh and Pt catalysts [3].

In this talk, I will present the use of hydrosilylation reactions in modern chemistry, using the hydrosilylation of terminal and internal alkynes as an example. The influence of catalysts on the products obtained by this reaction will also be discussed.

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Antioxidant compounds in human breastmilk

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Abstract:

Human milk constitutes the best nourishment for newborns. It is an irreplaceable source of energy and numerous significant substances, such as proteins, carbohydrates, minerals, antioxidants, and vitamins. Consumption of breastmilk has beneficial effects on the construction of infants' immune system, child's proper growth and development. The composition of maternal milk depends on the health and diet of a mother, the stage of lactation, and some environmental factors [1].

Antioxidants are beneficial substances, that may be found in fruits and vegetables. Their positive effect on neutralizing free radicals stops oxidative stress and protects new cells from damage. The most common and best-known groups of antioxidants are polyphenols, carotenoids, tocopherols, and vitamin C [2]. In this work, different procedures of sample preparation and determination of these compounds are presented.

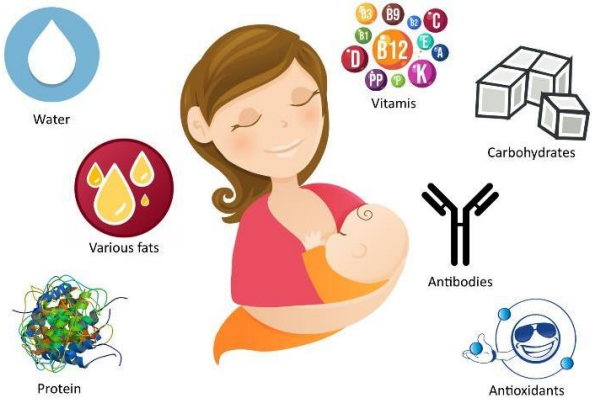

Fig. 1. Composition of human breastmilk [3].

Literature:

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Method for the rapid identification of the volatile organic compounds profile of *Zadurella* tomatoes stored under different conditions

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Abstract:

The volatile organic compounds (VOCs) profile is an essential indicator of the quality of food products, allowing the influence of various factors on them to be examined and assessed. The electronic nose method combined with headspace and chemometrics makes it possible to quickly determine the profile of volatile compounds and indicate the main compounds creating the VOCs profile. [1]. This method was used to compare changes in the VOCs of Zadurella tomatoes under refrigeration (4°C±1°C and 10°C±1°C) and at room temperature (20°C±1°C) (Fig. 1). There were 17 compounds, mainly aldehydes and alcohols. PCA analysis showed that VOC profiles in tomatoes varied depending on storage temperature.

Storing tomatoes at 4°C had a negative impact on the profile of volatile compounds. However, storage at temperatures of 10°C and 20°C resulted in similar profiles of VOCs. The results are an essential basis for developing a rapid method for assessing the quality of the raw material and storage strategies for less popular tomato varieties to preserve their characteristic features [2].

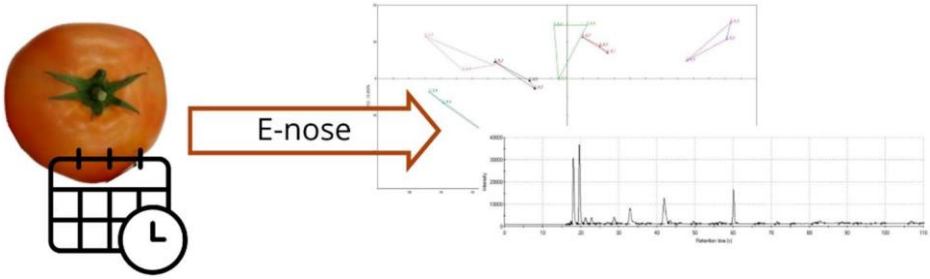

Fig. 1. Identifying the volatile organic compounds profile

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Posters

Inverse-electron-demand Diels-Alder reaction

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Abstract:

An intriguing class of cycloaddition reactions are inverse-electron-demand Diels–Alder (iEDDA) reactions. They have attracted increasing attention for their application in the total synthesis of natural products, biorthogonal chemistry and materials science [1].

Inverse-electron-demand Diels–Alder (iEDDA) reactions (Fig 1.) are [4+2]-cycloaddition between a diene and a dienophile to form a six-membered ring via suprafacial interaction and are governed by the $HOMO_{dienophile}$ – $LUMO_{diene}$ gap [2]. Therefore, the incorporation of electronwithdrawing groups in a diene structure lowers a LUMO state and subsequently accelerates the reaction rate. Electron-donating substituents raise the HOMO of the dienophile, which makes them preferable.

Inverse-electron-demand Diels-Alder reactions are rapid and selective coupling reactions without the need for any catalyst. They have been applied in the bioconjugation of radiolabeled biomarkers, in the drug delivery, and have found many other applications [3].

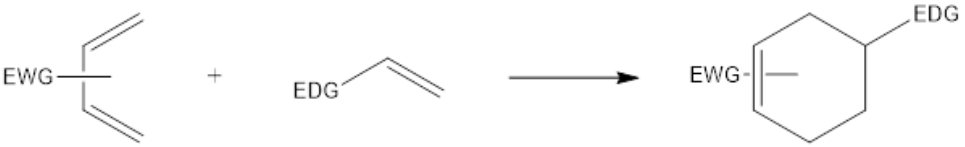

Fig. 1. Scheme of an inverse-electron-demand Diels-Alder reaction.

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Materials of the future based on MOFs – photocatalysts for generating hydrogen and purifying water

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Abstract:

Metal-organic frameworks (MOFs) are among the most promising materials of the future, with a wide range of applications, including as photocatalysts for hydrogen generation and water purification. Due to their unique structure, characterized by high porosity and large surface area, MOFs offer exceptional capabilities in gas storage and separation, as well as in chemical catalysis. This presentation will discuss the latest advancements in the use of MOFs as photocatalysts, focusing on their mechanisms of action, efficiency, and stability. Special attention will be given to the ability of MOFs to efficiently generate hydrogen from water under sunlight, which is a crucial step towards sustainable energy production. Additionally, we will present innovative solutions based on MOFs in water purification processes, including the removal of organic pollutants and heavy metals. Our research demonstrates that MOFs have the potential to revolutionize energy and environmental technologies, opening new possibilities for sustainable development.

Effect of indolylacetic acid (IAA) and different sucrose concentrations on *in vitro* rooting of *Linaria loeselii* Schweig.

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Abstract:

Indolylacetic acid (IAA) is known for its role in regulating plant growth and development processes such as rooting. Increased sucrose concentrations can have a beneficial effect on root development by providing an proper source of energy for cell metabolism. However, excessively high concentrations of sucrose can lead to osmotic stress, which can be detrimental to plant growth processes [1].

In vitro plant rooting studies are important for plant propagation under controlled conditions. In the present study, the effect of different concentrations of (IAA) and sucrose on the *in vitro* rooting process of shoots of *Linaria loeselii* was analysed. Shoots were collected from plants *in vitro* culture and placed in ½ MS medium (Murashige and Skoog) supplemented with IAA at different concentrations (0, 0.1, 1.0, 1.5 mg/L) and sucrose (2, 4, 6, 8, 10%). After 4 weeks of incubation, the number and length of roots, and the overall condition of the cultures were assessed. The results showed that both IAA and sucrose concentrations had a significant effect on *in vitro* rooting of *Linaria loeselii.* IAA concentrations in the range of 1.5 mg/L and sucrose concentrations of 4% were most effective in stimulating rooting. However, higher concentrations of IAA and sucrose could lead to negative effects such as stunted root growth and the deterioration of plant health.

The authors are grateful to Magdalena Lazarus, PhD from Department of Plant Taxonomy and Nature Conservation, University of Gdansk for providing Linaria loeselii seeds for the research.

Literature:

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Proteomic response of lupine root to drought

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Abstract:

It is estimated that abiotic factors limit global crop productivity by up to 50%. Among all abiotic stresses water deficit in soil has the strongest effect on the functioning of both the green part of the plant as well as root which is the first place of drought perception [1]. Therefore it is crucial to get knowledge about the responses of economically important species to water deficit. Extremely sensitive to these conditions is yellow lupine (*Lupinus luteus* L.) which showed a strong reduction in yield when grown in the water-limited environment [2, 3]. Here we examined the proteome response of lupine root to this stress. Electrophoretic separation of proteins extracted from drought-stressed lupine roots and gels scanning revealed the presence of 17 bands, of which 4 appeared under drought, while 10 disappeared in these conditions. The rest of the bands were presented both in stressed and control extracts. Analyses of differential proteins were performed using peptide mass fingerprinting and matrix-assisted laser desorption/ionization coupled with time-of-flight (MALDI-TOF/TOF). A database search revealed that the identified proteins are characterized by the highest homology to those involved in transcription/translation regulatory network, transport, metabolic processes, cell wall remodeling, ion transport, mRNA processing, storage of products, protein modification, and defense reactions (e.g.: heat stress transcription factors, non-specific lipid-transfer proteins, sucrose synthase 1, expansin-B16, thioredoxin F-type, maturase K, glycinin G1, putative defensin-like proteins, chaperonins). The obtained results provide novel insight into the response of crops to drought at the proteomic level. Based on the selected proteins, specific stress-sensitive metabolic pathways have been chosen which could be useful in further analyses and management strategies oriented toward the improvement of plant adaptation and survival under stress.

Research work partly funded by the 2020-2024 science budget as a research project under the Diamond Grant IX program no. 0180/DIA/2020/49

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A hybrid system containing graphene quantum dots covalently bonded to magnetite nanoparticles

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Abstract:

The subject of thiswork was synthesis of hybryd composites: Fe_3O_4@APTMS-GQDs and Fe_3O_4@APTES-GQDs. Composites have in its structure the carboxyl groups located at the end of the GQDs molecule and the amino groups located on the outside of the magnetic nanoparticles. The transformation of carboxyl groups into more reactive ester groups and the modification of the magnetite surface with silica of various lengths chain made it possibile to create a permanent covalent bond formed as a result of the amidation reaction between these composites. Then, the obtained composite material was subjected to physicochemical tests to find differences in structure morphology, dispersibility and particle size and also carried out electrochemical characteristics to check the capacity capabilities and potential applications of the material.

FTIR (Fourier Transform Infrared Spectroscopy) allows the observation of characteristic bands marking the presence of individual components: graphene-derived structures, magnetic nanoparticles and silica chains.

Using DLS (Dynamic light scattering), it is possible to examine the statistical distribution of hydrodynamic diameters, homogeneity, dispersity and the influence of the hydration shell thickness on the size of the obtained nanoparticles.

Electrochemical characterization allows determining the presence of individual components and obtaining a covalent bond through amidation reaction.

TEM (Transmission electron microscopy) and SEM (Scanning electron microscopy) microscopy allows to examine the porosity, morphology and aggregation of nanoparticles.

The research carried out in this work allowed for a preliminary assessment of the properties of the obtained Fe_3O_4@APTES-GQDsand Fe_3O_4@APTMS-GQDs composites. The presence of two types of silica undoubtedly influenced the observed discrepancies in the physicochemical properties of the obtained materials. Additionally, the presence of agraphene-derived structure modifiedthe properties of the composites obtained after functionalization with silica, which could ultimately expand the range of applications ofthe tested material.

Physicochemical Properties and Applications in Photocatalysis of New Cu(I) Complexes with 1,10-Phenanthroline Derivatives

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Abstract:

More than 80% of the currently sourced energy comes from fossil fuels [1], which resources are becoming increasingly limited and their obtaining is not environmentally neutral.

For this reason, it becomes urgent to develop a method for energy generation that will not impose such a burden on the natural environment. Looking for inspiration in nature, research is underway to take advantage of commonly available sunlight. For several decades, processes imitating photosynthesis have been developed, which, by exciting photosynthetic light-harvesting antennae, enable electron transfer processes, thereby making the oxidation of water and reduction of CO_2 possible [2]. It is also associated with the potential reduction of the amount of CO_2 in the atmosphere [3] and the production of C1-compounds (such as CO, CH_2O, etc.) that could serve as substrates in the synthesis of new organic compounds.

In artificial photosynthesis it is necessary to design an appropriate photosensitizer and a catalyst. The systems developed so far have often been based on precious metals, the obtaining of which is associated with high costs due to their limited availability. The application of copper(I) complexes is a promising alternative which meets the assumptions of green chemistry. Copper is a metal commonly found in the Earth's crust. What's more, copper has a $3d^{10}$ electronic configuration, therefore metal-centred (d-d) excited states are forbidden, while metal-to-ligand charge transfer states, often associated with absorption in the visible region of the electromagnetic spectrum, are allowed [4,5].

In the poster presentation, methods for synthesizing new heteroleptic Cu(I) complexes with 1,10-phenanthroline will be presented, and their photophysical and electrochemical properties will be discussed.

Literature:

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Smart and Biodegradable Drug Carriers: Minimizing Toxicity to Healthy Cells through Stimuli-Responsive Capsules

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Abstract:

Nanomaterial-based drug delivery systems (DDS), particularly polymeric microgels, offer promising avenues for enhancing drug efficacy and minimizing toxicity. These microgels possess a three-dimensional porous structure composed of cross-linked hydrophilic polymers, enabling sensitivity to physiological changes such as pH, temperature, and redox conditions [1]. Moreover, their biodegradable and biocompatible nature, coupled with a high surface area, renders them suitable for various biomedical applications, including cancer therapy [2].

Crosslinking agents, such as N,N'-bis(acryloyl)cystine (BISS), facilitate mechanical strength, with disulfide-linkages offering degradability under reducing conditions found in cancerous tissues. Additionally, templating techniques, employing safe and controllable templates like silica, allow for the facile synthesis of polymer capsules with high encapsulation capacity and desired properties [3]. In this work, novel hollow hydrogel capsules, fabricated from stimuli-sensitive and degradable polymers, were synthesized via a facile method based on precipitation polymerization of N-isopropylacrylamide (NIPA) with the crosslinking agent BISS on -C=C- modified sacrificial dimethyldiethoxysilane emulsion templates (DMDES). The resulting capsules were formed upon the removal of the silica core by ethanol treatment. The incorporation of carboxylic groups from BISS conferred stability and pH sensitivity to the capsules. Additionally, the presence of -S-S- groups rendered the polymer network susceptible to degradation by the reducing agent glutathione, which is abundant in elevated concentrations in certain cancer cells. The anticancer drug Doxorubicin (DOX) was efficiently loaded into and released from the capsules upon degradation. Optimal drug release was observed at 37°C and cGSH = 40 mM, aligning well with conditions typically found in cancer cells. Evaluation via MTT assay demonstrated that the DOX-loaded capsules exhibited enhanced cytotoxicity against MCF-7 breast cancer cells compared to free DOX, while displaying reduced toxicity towards healthy MCF-10A cells. The unloaded gel nanoparticles did not inhibit proliferation of the cells.

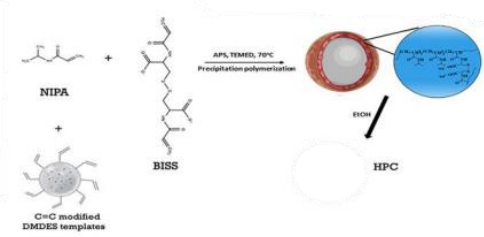

Fig. 1. Synthesis of p(NIPA-BISS) hollow microgel.

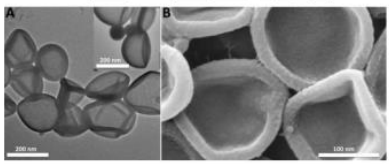

Fig. 2. TEM (A) and SEM (B) images of the hollow polymer capsules. Inset – higher magnification.

Literature:

[1] R.J. Wang, H.T. Yang, A.R. Khan, X.Y. Yang, J.K. Xu, J.B. Ji, G.X. Zhai, Redox-responsive hyaluronic acid-based nanoparticles for targeted photodynamic therapy/chemotherapy against breast cancer, J. Colloid Interface. Sci. 598 (2021) 213–228.

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The use of analytical chemistry in the identification of document forgeries

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Abstract:

Presenting the applications of analytical chemistry methods in identifying document forgeries is imperative in the context of a global challenge that is not always properly appreciated[1][2]. Investigating the possibilities of detecting counterfeits using these techniques highlights the importance of the problem and raises awareness of the need to effectively respond to this form of crime.

Analytical chemistry methods are extremely important tools in the fight against document forgery. Their use enables precise identification of differences in chemical composition between authentic and counterfeit documents, which is crucial in the process of detecting forgeries[3]. Thanks to the increasing availability and progress in analytical technologies, we are able to examine their chemical composition more precisely and without disturbing documents. This, in turn, helps us better deal with document fraud.

The use of methods such as spectroscopy, chromatography or microscopic analysis with chemical imaging enables detailed examination of the chemical composition of various document elements, such as inks, stamps, paper and additional anti-counterfeiting protection. For example, Raman spectroscopy allows the identification of unique chemical signatures of substances used in the production of documents, which can be used to detect counterfeit documents[4].

Ultimately, the use of analytical chemistry methods in identifying document forgeries not only makes it possible to detect and neutralize forgeries, but also contributes to maintaining the integrity of documentation[3][6], which is fundamental to maintaining public trust and the effectiveness of legal and administrative systems.

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The use of conductometric for the thermodynamic description of the properties of a selected imidazole derivative ionic liquid in formamide in a wide temperature range.

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Abstract:

The application of the conductometric method for determining the physicochemical parameters of an imidazole-derived ionic liquid in formamide over a wide range of temperatures has been presented as an alternative method to well-known techniques such as calorimetry or NMR. The study demonstrates an innovative perspective on the dynamically evolving branch of chemistry related to ionic liquids, which find applications primarily in the fuel cell industry as well as in green chemistry. The investigated imidazole-derived ionic liquids in an organic solvent such as formamide demonstrate their suitability for application in the chemical or pharmaceutical industry. The discussed conductometric method is highly accurate as it considers all variables describing the determined limiting conductivities in the equations, allowing for the calculation of association constants and the conductance of a complete thermodynamic analysis of the studied process as a function of temperature. Until now, researchers attempting to determine the physicochemical properties of similar objects primarily relied on calorimetry. By conducting measurements, we can quickly and with great precision analyze most of the physicochemical parameters of the studied system. The proposed calculations obtained through the application of the innovative conductometric method may benefit other research units in the field of chemistry as well as industry.

Literature:

[1] Zhu A., Wang J., Han L., Fan M. 2009. Measurements and correlation of viscosities and conductivities for the mixtures of imidazolium ionic liquids with molecular solutes. *Chem. Eng. J 147*: 27–35.
[2]Welton T. 2004. Ionic liquids in catalysis. *Coordination Chemistry Reviews 248*: 2459-2477.
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[4] Application of Ionic Liquids in Biocatalysis, Chapter February 2011.
[5] Kinart Z. 2023. Electrical Conductivity of Ionic Liquids 1-Hexyl-3-Methylimidazolium Chloride (HMIM) and 1-Methyl-3-Octylimidazolium Chloride (OMIM) in Mixtures with Selected Alkoxy Alcohols over a Wide Temperature Range. *Molecules 28*: 7831.

Erlenmeyer-Plöchl reaction – synthesis of biologically active molecules

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Abstract:

Erlenmeyer-Plöchl reaction, a modification of the Perkin reaction, is a synthesis of azlactones, but also an opportunity to obtain amino-acids and derivatives of 2-oxo-3-phenylpropanoic acid. The condensation of aromatic aldehydes, hippuric acid with sodium acetate and acetic anhydride result in the formation of 4-arylidene-2-phenyl-5(4H)-oxazolones [1]. Oxazolones (also called azlactones) are intermediates for the synthesis of precursors of several biologically active molecules. The reduction of the oxazolones give derivatives of phenylalanine. Additionally, derivatives of 2-oxo-3-phenylpropanoic acid are synthesized in acid or basic hydrolysis of oxazolones. Azlactones are also biologically active molecules and present a wide range of pharmaceutical properties like immunomodulatory activity. Owing to fluorescent properties, derivatives of 4-arylidene-2-phenyl-5(4H)-oxazolones are also used in photochemistry and materials sciences [2].

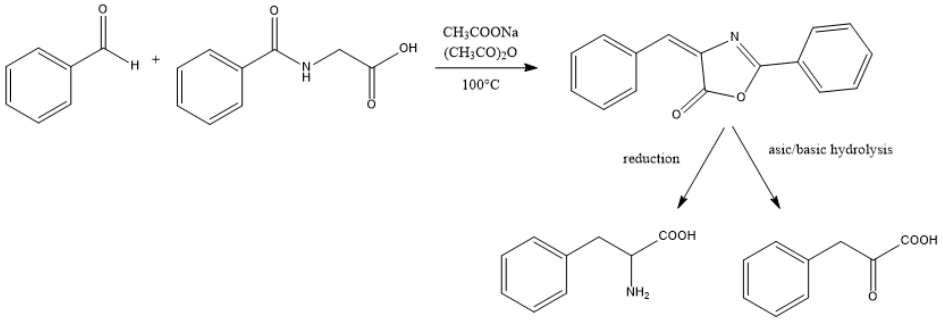

Fig. 1. Erlenmeyer-Plöchl reaction.

Literature:

[1] Cleary T., Rawalpally T., Kennedy N., Chavez F. 2010. Catalyzing the Erlenmeyer Plöchl reaction: organic bases versus sodium acetate. Tetrahedron Letters, 51(12): 1533–1536.

[2] Rodrigues C., Martinho J., Afonso C. 2015. Synthesis of a Biologically Active Oxazol-5-(4H)-one via an Erlenmeyer–Plöchl Reaction. Journal of Chemical Education, 92(9): 1543–1546.

Synthesis and Characterization of Hyaluronic Acid-Modified Hydrogel for Stain Sensors

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[1] *Faculty of Chemistry, Biological and Chemical Research Center, University of Warsaw, 101 ˙Zwirki i Wigury Av., PL 02-089 Warsaw, Poland*
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Abstract:

Hydrogels are versatile materials with potential applications in various fields [1]. In this study, we synthesized a novel hydrogel for strain sensing applications by incorporating hyaluronic acid into an acrylic acid-based network, along with Fe^{3+} ions for self-healing properties through reversible metal-ligand coordination bonds.

We comprehensively evaluated the mechanical properties, rheological behavior, self-healing efficiency, adhesiveness, antibacterial activity, antioxidant capacity, and strain sensitivity of the hydrogel. The addition of hyaluronic acid improved mechanical strength (Fig. 1), while Fe^{3+} ions enabled self-healing. Additionally, the hydrogel exhibited adhesiveness and antibacterial and antioxidant properties.

Preliminary strain sensitivity experiments revealed the hydrogel's responsiveness to mechanical stimuli, indicating its potential as a strain sensor. Our findings suggest that this hydrogel is promising for strain-sensing applications due to its robustness, self-healing capabilities, and responsiveness to external stimuli [2].

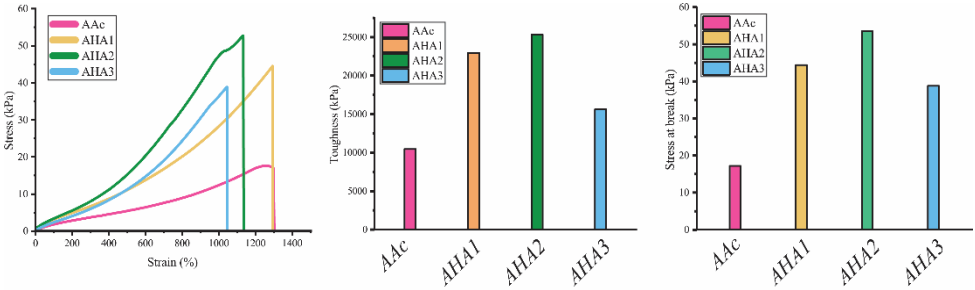

Fig. 1. Comparison of tensile properties of the hydrogel before and after adding hyaluronic acid.

Literature:

[1] Gharakhloo M., Karbarz M. 2022. Autonomous self-healing hydrogels: Recent development in fabrication strategies. European Polymer Journal, 165(November 2021), 111004.

[2] Luo J., Wang H., Wang J., Chen Y., Li C., Zhong K., Xiang J., Jia P. 2023. Fabrication of a High-Strength, Tough, Swelling-Resistant, Conductive Hydrogel via Ion Cross-Linking, Directional Freeze-Drying, and Rehydration, 9(5), 2694–2705.

Use of surface-supported polylactide particles as a doxorubicin carrier

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Abstract:

The main subject of my work is preparation of biodegradable polymer particles, which can act as carriers of anticancer drugs. Polymer particles are fabricated from polylactide employing the dewetting phenomenon. A thin polylactide film is spin-coated onto a glass slide, followed by melting the polymer in contact with a high boiling point, polar solvent (glycerol). Cooling down the sample yields nano- or micrometer-sized polymer particles attached to the glass surface. The particles can be used to incorporated guest species, e.g. doxorubicin (an anticancer drug) [1].

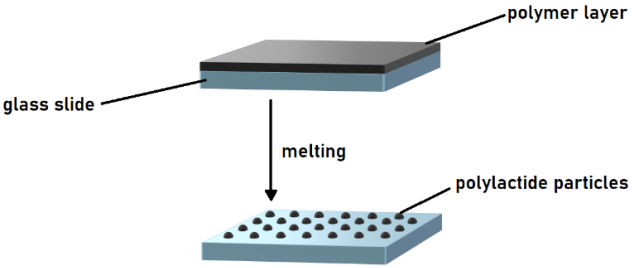

Fig. 1. Preparation of surface-supported polylactide particles by melting polylactide layer in contact with glycerol.

Literature:

[1] Kuśmierz B., Wysocki K., Chotkowski M., Mojzych I., Mazur M. 2022. Preparation of surface-supported polylactide spherical-cap particles. Langmuir, 38(48):14596–14606. PMID: 36395585.

Using the MS-DWS method to determine the gelling and melting temperature of carrageenan glazing gels

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Warsaw University of Life Sciences, Institute of Food Sciences, [1]Department of Chemistry, [2]Department of Food Engineering and Process Management, [3]University of Zagreb, Faculty of Food Technology and Biotechnology, Department of Food Engineering

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Abstract:

Glazing gels used as decorative gels are most often applied by hot spraying of solutions based on fast-setting hydrocolloids. The formation of a non-sticky gel at room conditions is crucial for their use. Therefore, the thermal gelation properties of the feed material and its rheological properties at different temperatures should be taken into consideration when designing the production conditions for glazing gels.

The objectives of this study was to monitor gel formation and gel melting during cooling-heating cycles of carrageenan based glazing gels in combination with different sweetener replacements to obtain the critical sol-gel and gel-sol transitions temperatures via the temperature sweep tests using the Multispectle-Diffusing Wave Spectroscopy (MS-DWS).

MS-DWS, as opposed to oscillatory rheology, allowed determining of the characteristic temperatures at the beginning, middle and end of the phase transitions. The rheology gelling temperatures correlated best with the end of the gelation process, while the melting temperatures corresponded to the middle point temperature of the MS-DWS.

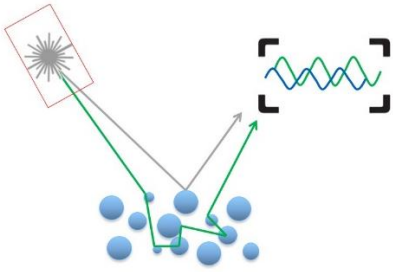

Fig. 1. Principle of measurements: Multispectle-Diffusing Wave Spectroscopy .

Literature:

[1] Górska A., Mańko-Jurkowska D., Domian E. 2024. Comparative gelation characteristics of carrageenan via rheological and optical techniques: Glazing gels with different sweeteners. Food Hydrocolloids, 152: 109941.

Design and Synthesis of Steroid Conjugates connected via a 1,2,3-Triazole Linker

Grzegorz Hajdaś[1], Tomasz Pospieszny, Hanna Koenig

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Abstract:

New steroid conjugates linked by a 1,2,3-triazole ring were synthesized using a Cu(I)-catalyzed Huisgen reaction between steroid derivatives containing terminal multiple bonds or azide groups [1]. Figure 1 shows a schematic example of the "Click" chemistry reactions, which are known for their high yields, straightforward reaction conditions, and stability under physiological conditions [2].

The structures of all conjugates were confirmed using spectral techniques, mass spectrometry and semiempirical methods. The pharmacotherapeutic potential of the synthesized compounds was initially assessed using the PASS program and molecular docking. The cytotoxicity of the compounds was evaluated *in vitro* in a hemolytic test. Results indicate that selected compounds exhibit interesting biological activity.

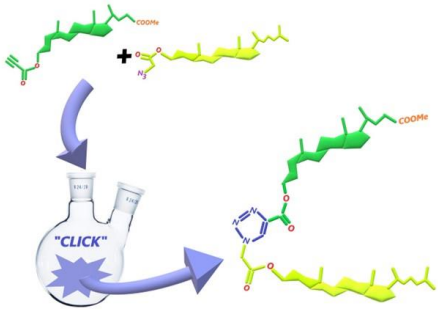

Fig. 1. Model representation of "Click" chemistry reaction.

Literature:

[1] Bansal, R., Suryan, A. 2022. A Comprehensive Review on Steroidal Bioconjugates as Promising Leads in Drug Discovery. ACS Bio Med Chem Au, 2(4): 340–369.

[2] Meldal, M.; Diness, F. 2020. Recent Fascinating Aspects of the CuAAC Click Reaction. Trends in Chemistry, 2(6): 569–584.

The chemistry of love - what does it mean?

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Abstract:

Each of us loves in a different way, some of us behave like crazy and others don't feel so emotionally aroused. If we love someone, then our hearts beat faster and our blood pressure rises. When two people fall in love with each other, a chemical storm takes place in their brains. The word “love” is understood as a feeling, but most of us forget the chemical aspect of it. Neurohormones produced in the body are responsible for feeling emotions. That's why we feel a surge of energy and happiness, crave physical contact, and tolerate pain better.

Such substances include, among others, serotonin, dopamine, oxytocin, endorphins and many others. Dopamine makes you look at your partner uncritically and find their flaws cute. Endorphins make us want to do things we didn't want to do before. In addition, they increase satisfaction and reduce stress. Thanks to oxytocin, we can fall in love and form
a close relationship. It facilitates the development of the female maternal instinct. Serotonin is called the happiness hormone. It is created in the company of the person we love and regulates our sleep and appetite. Furthermore, it allows us to focus and concentrate [1].

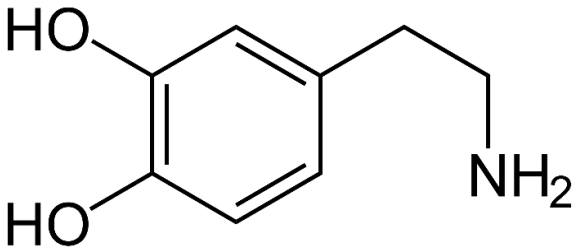

Fig. 1. The chemical formula of dopamine..

Literature:

[1] Germak M. 2021. The Golden Four Among Hormones. What is the difference between dopamine, serotonin, endorphin and oxytocin, and how do they improve our mood?

Silicone-based 3D printing for Electrochemical applications

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Abstract:

Direct Ink Writing (DIW) known as Direct Ink Fabrication or robocasting is one of the 3D printing techniques similar to fused deposition modeling (FDM) with the biggest difference being the extrusion process. For the latter it is controlled with the applied pressure. In DIW we use liquids with optimal rheological properties [1]. Inks used in DIW are made out of pure components such as polymeric solutions or mixtures of the viscous phase and additives such as graphene and graphene oxides, nano or micro particles of metals and their oxides, and proteins [2].

The purpose of the project is to create organic solvent resistive electrochemical cell made from silicone (Fig 1). It will provide a cheap and useful addition to laboratory equipment which can be built and modified according to need. The study consists of three stages: 1) Optimization of silicone-based printing, 2) Printing predesigned cell, 3) Analysis of different physical and chemical variables which may affect the cell and printing performance.

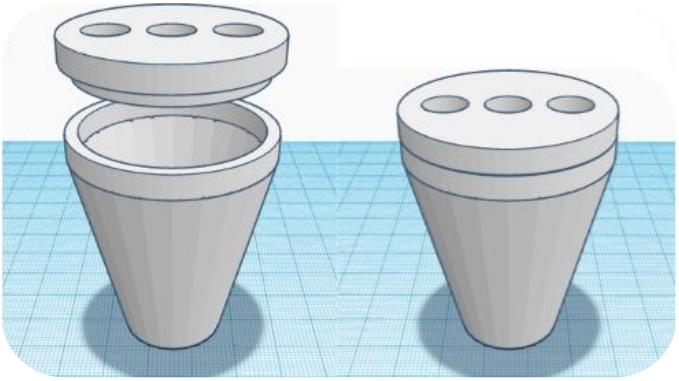

Fig. 1.STL model of electrochemical cell.

Research financed by Student research Grants VIII edition

Literature:

[1] Pinargote N. W. S., Smirnov A., Peretyagin N., Seleznev A., Peretyagin P. 2020. Direct ink writing technology (3d printing) of graphene-based ceramic nanocomposites: A review. Nanomaterials 10(7)
[2] Hartings M. R., Ahmed Z. 2019. Nature Reviews Chemistry 3(5): 305-314

Ecotoxicity of flufenamic acid - a study with *Chlamydomonas reinhardtii* and *Desmodesmus armatus*

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Abstract:

In aquatic environment non-steroidal anti-inflammatory drugs (NSAIDs) represent a significant category of pollutants. NSAIDs pose a serious threat to aquatic ecosystems, with microalgae being particularly sensitive. These green organisms play a key role in aquatic ecosystems, contributing to nutrient cycling, primary production, and ecosystem stability. Furthermore, their unique metabolic capabilities make them promising candidates for the remediation of NSAIDs contamination.

The study aimed to compare the toxicity of flufenamic acid (FFA) towards *Chlamydomonas reinhardtii* and *Desmodesmus armatus*. The research hypothesis assumes that *D. armatus* will show higher resistance to the tested NSAID than *C. reinhardtii*. To test this hypothesis, toxicological parameters EC (effective concentration) were determined and the effect of FFA on the intensity of photosynthesis, dark respiration, and the mitochondrial membrane potential were determined.

D. armatus was less resistant to FFA ($EC_{50\text{-}24}$ = 2.34 mg/L) than *C. reinhardtii* ($EC_{50\text{-}24}$ = 35.47 mg/L). Interestingly, the effect of FFA on the intensity of photosynthesis and dark respiration was different in the tested organisms. The intensity of these processes was increased in *D. armatus* and almost completely inhibited in *C. reinhardtii* compared to the control. A decrease in the mitochondrial membrane potential was observed in both strains, but in *C. reinhardtii* it was more pronounced.

The obtained results indicate different toxicity of FFA towards various microalgae strains. The presence of NSAIDs in the aquatic environment therefore poses a potential risk to the development of microalgae populations, to the functioning of food chains based on these organisms, and, consequently, can lead to the disequilibrium of ecosystems.

This work was funded by the National Science Centre of Poland (OPUS 2019/35/B/NZ9/01567).

Synthesis of new steroid–uracyl conjugates using the „click" chemistry method

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Abstract:

Steroid conjugates are essential natural products due to their participation in most metabolic transformations. Using the effective „click" chemistry method, five new bile acid/sterol-uracil derivatives connected with 1,2,3–triazole rings (**1**–**5**) were synthesized. The steroid-pyrimidine bioconjugates obtained by azide-alkyne cycloaddition were subjected to complete spectroscopic characterization (^{1}H NMR, ^{13}C NMR, FT-IR), mass spectrometry (ESI-MS) and theoretical calculations enabling the determination of their most optimal molecular models. The pharmacotherapeutic potential of the obtained compounds was estimated based on *in silico* studies using the PASS method.

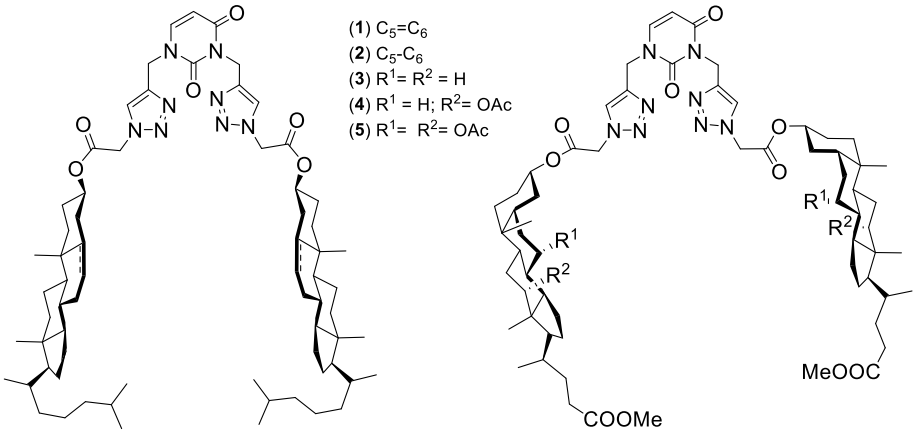

Fig. 1. New steroid-uracil bioconjugates (**1**–**5**).

Literature:

[1] Kandi S., Godishala P., Rao P., Ramana K. V. 2015. Biomedical significance of terpenes: an insight. Biomedicine, 3: 8–10

[2] Devaraj N. K., Finn M. G. 2021. Introduction: click chemistry. Chemical Review, 121: 6697–6698.

[3] Pospieszny T., Koenig H. 2021. Design, synthesis, spectral and theoretical study of new bile acids–sterol conjugates linked *via* 1,2,3–triazole ring. Steroids, 176: 130814

[4] Kawka A., Hajdaś G., Kulaga D., Koenig H., Kowalczyk I., Pospieszny T. 2023. Molecular structure, spectral and theoretical study of new type bile acid–sterol conjugates linked via 1,2,3-triazole ring. Journal of Molecular Structure, 1273: 134313

Amino acid-based hydrogels with high stretchability and motion sensitivity for wearable motion Sensors

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Abstract:

Considerable interest in conductive hydrogels and their use in electrical stimulation therapy and health testing has been shown. In order to improve hydrogels' intrinsic brittleness and limited conductivity, a double network structure with metal ions was created. For this purpose, a P(AM_AcOr_Gelatin) hydrogel was synthesized by combination of gelatin, a biocompatible polymer, N-δ-acryloyl-ornithine (AcOr), an amino-acid derivative, and acrylamide (AM). Since the amino acid-based monomer delivered charged groups to the hydrogel network, the hydrogel gained motion sensitivity properties compared to polyacrylamide (PAM) hydrogels. Moreover, we modified the P(AM_AcOr_Gelatin) hydrogel by immersing Fe^{3+} and Cu^{2+} ions; P(AM_AcOr_Gelatin)-Fe^{3+} and P(AM_AcOr_Gelatin)-Cu^{2+} hydrogels were obtained. The metal-containing hydrogels had coordination bonds between gelatin, AcOr and the ions, and other noncovalent bonds, which led to improved conductivity, strengthened mechanical properties (tensile stress of 3500-8400 Pa, tensile elongation of 900-1000%, compressive stress of circa 3000-4000 Pa) and better conductivity. The developed hydrogels make significant promise for progress in wearable technology and construction of electronic skin sensor. They may also contribute to the creation of intelligent skin-like sensors [1].

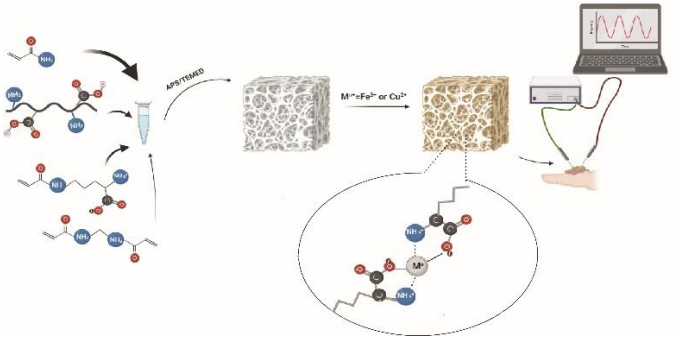

Fig. 1. Polymerization and modification scheme of synthesized hydrogel, and motion sensor performance

Literature:

[1] Khodami, S., Kaniewska, K., Stojek, Z., Karbarz, M. 2022. Hybrid double-network dual crosslinked hydrogel with self-healing ability and mechanical stability. Synthesis, characterization and application for motion sensors. Eur. Polym. J., 173: 111258.

Why printing hydrogel dressings is a worthwhile idea?

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Abstract:

3D printing is a technology gaining popularity due to its flexibility and the potential for developing the technique. One branch of this technology is bioprinting - the technique that allows the printing of materials and enriching them with biologically active ingredients and cells to obtain structures resembling tissues or supporting their functioning. In this case, natural polymers are mainly used instead of synthetic polymers and resins.

One potential application of the technology is the production of dressings used, for example, for treating burns. Despite the existence of cheaper and less time-consuming alternatives such as traditional dressings made of cotton or more modern dressings made by pouring and subjecting to a crosslinking agent a hydrogel polymer material, more research continues to emerge on the production of dressings using 3D bioprinting techniques. The poster will exhibit and outline the topic of dressing production using 3D bioprinting technology, and attempt to answer the question of what potential benefits and advantages 3D printing has over traditional dressing production [1-4].

Literature:

[1]. Alizadehgiashi, Moien. 2021.Multifunctional 3D-printed wound dressings. ACS nano 15(7): 12375-12387.
[2]. Teoh, Jia Heng. 2021. 3D printing personalized, photocrosslinkable hydrogel wound dressings for the treatment of thermal burns. Advanced Functional Materials 31(48): 2105932.
[3]. Muwaffak, Zaid. 2017. Patient-specific 3D scanned and 3D printed antimicrobial polycaprolactone wound dressings. International journal of pharmaceutics 527(1-2): 161-170.
[4]. Milojević, Marko. 2021. Hybrid 3D printing of advanced hydrogel-based wound dressings with tailorable properties. Pharmaceutics 13(4): 564.

Micromorphology of leaves and flowers of representatives of the genus *Alchemilla* L. (*Rosaceae*)

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[1]*University of Gdansk, Faculty of Biology, Department of Plant Taxonomy and Nature Conservation*

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Abstract:

The purpose of this study was to identify and define the occurrence of selected micromorphological features on the leaf and flower in representatives of the genus *Alchemilla* L., as a potential source of taxonomic information.

The object of the study is the representatives of the genus *Alchemilla* L. belonging to the family *Rosaceae* Juss. The genus probably counts about 1000 species, including many so-called microspecies. Since the beginning of the 20th century, it has been known that many species of the genus *Alchemilla* reproduce by apomixis [1]. The occurrence of microspecies within the genus is associated with an observed high level of variability in morphological traits, but also in genetic traits [2]. However, many of the aspects described, are still debatable, so there is a need for more research to solve the mentioned scientific problems [3].

The research material consisted of specimens of 2 species belonging to the genus *Alchemilla*, *A. micans* Buser and *A. subcrenata* Buster. The research was carried out in cooperation with the Electron Microscopy Section at the Faculty of Biology of the University of Gdansk using a Scanning Electron Microscope (SEM).

Trichomes occurring on the surface of the leaf epidermis and flowers were analyzed. The study revealed great variability in the distribution of trichomes. There were relatively more trichomes on the ventral side of the leaf than on the dorsal side in both species. In contrast, the most important difference in flower structure is the occurrence of trichomes on the underside of the calyx sepals, which are found only in *A. subcrenata*.

Based on the results obtained, the variability in the studied micromorphological traits in individual taxa was found. The pilot study conducted and the results obtained can indicate the taxonomic value of the analyzed traits. Moreover, they can be used in species classification and as valuable traits for the creation of a key for species determination.

Literature:

[1] Pihu S., Hõimra J., Köster E., Pärtel M. 2009. Environmentally Dependent Morphological Variability in Seven Apomictic Microspecies from *Alchemilla* L. (*Rosaceae*). Folia Geobot 159–176.

[2] Rono, P. C., Dong, X., Yang, J. X., Mutie, F. M., Oulo, M. A., Malombe, I., Wang, Q. F. 2020. Initial Complete Chloroplast Genomes of *Alchemilla* (*Rosaceae*): Comparative Analysis and Phylogenetic Relationships. Frontiers in genetics, 1390.

[3] Sepp S., Paal J. 1998. Taxonomic continuum of *Alchemilla* L. (*Rosaceae*) in Estonia. Nord. J. Bot., 519-535.

Fabrication of titanate-germanate glasses co-doped with Pr^{3+}/Er^{3+}: From synthesis to near-IR luminescence properties for optical applications

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Abstract:

In this study, three series of Pr^{3+}/Er^{3+}-titanate-germanate glass systems [1, 2] with various TiO_2:GeO_2 molar ratios were synthesized and then investigated using luminescence spectroscopy. The correlation between their spectroscopic properties and the effect of Pr^{3+}/Er^{3+} concentration in titanate-germanate was analyzed in detail. Fabricated optical materials were characterized based on measurements of the absorption spectra, near-IR emission spectra, and their decays. Especially, near-infrared luminescence associated to the $^1G_4 \rightarrow {}^3H_5$ (Pr^{3+}), $^1D_2 \rightarrow {}^1G_4$ (Pr^{3+}) and $^4I_{13/2} \rightarrow {}^4I_{15/2}$ (Er^{3+}) transitions was successfully observed under direct excitation at 488 nm. Interestingly, under excitation at 590 nm glasses exhibited other luminescence profiles corresponding to main laser transition of trivalent praseodymium and erbium ions. Importantly, their relative intensity ratios strongly depend on chemical composition of matrix and rare earth ions content. For this reason, special attention has been paid to these optical aspects. The above results are considered in the framework of novel optical glasses for photonic applications.

Fig. 1. Fabricated titanate-germanate glass samples co-doped with various Pr_2O_3 and Er_2O_3 content.

This research was funded by the National Science Centre (Poland), grant number 2018/31/B/ST8/00166.

Literature:

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Research on the development of a biosensor for the determination of C-peptide using screen-printed electrodes

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Abstract:

With each passing year, the number of individuals engaging in poor dietary habits or leading sedentary lifestyles is on the rise. Such behavior leads to an increase in diabetes cases, which if untreated can even lead to death. In the diagnosis of diabetes, tests measuring C-peptide levels can provide information about pancreatic function as well. Monitoring it is convenient because it remains in the body six times longer than insulin [1]. Currently, there is no biosensor available that would enable the analysis of C-peptide levels. All research is conducted in medical laboratories requiring blood samples from the patient.

In this study, the focus was on developing a biosensor for the determination of C-peptide using screen-printed electrodes (SPEs). The working electrode was modified using Halloysite, which aimed to increase the specific surface area, as well as Aniline or Melamine providing amino groups and forming amide bonds with carboxyl groups from antibodies. Additionally, Nafion® was employed to stabilize the formed layer on the electrode. In addition to the mentioned substances, a mixture of 1-ethyl-3-(3-dimethylaminopropyl) carbodiimide hydrochloride (EDC) and N-hydroxysuccinimide sodium salt (sulfo-NHS) was also utilized, along with bovine serum albumin (BSA). The EDC-sulfo-NHS mixture was used as a cross-linker to create a more stable amide bond between Aniline/Melamine and the antibody [2]. On the other hand, BSA prevents nonspecific binding of other molecules to the working electrode surface and enhances the stability of the formed layer. In the research, two electrochemical techniques were used: cyclic voltammetry (CV) providing information about reactions occurring in the system, and electrochemical impedance spectroscopy (EIS), informing about the electrode-electrolyte interaction. Two mixtures were analyzed, consisting of Halloysite, Nafion®, and Aniline in one, and Melamine in the other. Based on the results obtained from CV and EIS, the mixture containing Aniline was selected for further research, and the use of EDC-sulfo-NHS was rejected.

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Sodium folate as an efficient corrosion inhibitor for copper

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Abstract:

Corrosion inhibitors are commonly used in the industry to protect metals from costly damages. However, many chemical compounds used in this field are dangerous to living organisms and the environment. Therefore, eco-friendly compounds and natural substances that are capable of reducing the corrosion rates of metals are of interest to researchers.

In the present study, the folic acid salt- sodium folate was found to be an efficient, non-toxic and relatively cheap corrosion inhibitor for copper in chloride-containing media. Electrochemical impedance spectroscopy and weight-loss measurements show that inhibitor efficiency strongly depends on its concentration. The obtained results suggest that sodium folate is barrier inhibitor, and Langmuir adsorption model showed the best fit to the experimental data. Changes in inhibitor efficiency were also studied as functions of immersion time and temperature. Analysis of the obtained Arrhenius plots showed that the activation energy of the corrosion process increases in the presence of the inhibitor.

The results mentioned above are promising and have high application potential (e. g. for protecting copper elements in seawater). Further studies may be conducted to examine the inhibitor applicability in other environments (such as pickling solutions).

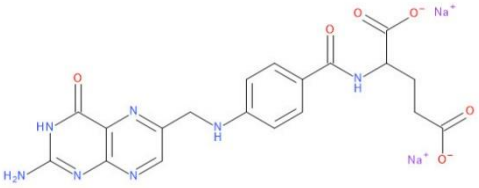

Fig. 1. Sodium folate structure.

Preparation and characterization of polycarbonate membranes coatings

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Abstract:

Polycarbonate nanoporous membranes enable selective transport of molecules of various sizes through pores, which makes them particularly useful in biomedical devices, filtration applications, as well as tools for controlled drug release. When using membranes in in vitro/in vivo applications, the transport of larger biological molecules is restricted, which leads to biofouling phenomenon, i.e. the physical adhesion and accumulation of various biological substances on the membrane. This may lead to the clogging of the membranes pores and impairing their selective transport performance. To avoid this, membrane surfaces can be modified by introducing different surface coatings based on polymers, which form mechanical barrier or alter surface properties, reducing attraction forces of the molecules toward membrane.

Therefore, the aim of this research was to assess the possibility of introducing various coatings on the surface of the polycarbonate membranes. Selected polymers included dextran, poly(ethylene glycol) (PEG), poly(acrylic acid) (PAA), polyvinylpyrrolidone (PVP), polydopamine (PDA) and graphene oxide (GO). The introduction of these coatings was confirmed via various techniques, including i.e. water contact angle (WCA), SEM and FTIR measurement. Additionally, the influence of the modifications on the diffusion parameters of the membranes was examined in a self-made 3-d printed diffusion chamber and with the use of toluidine blue dye.

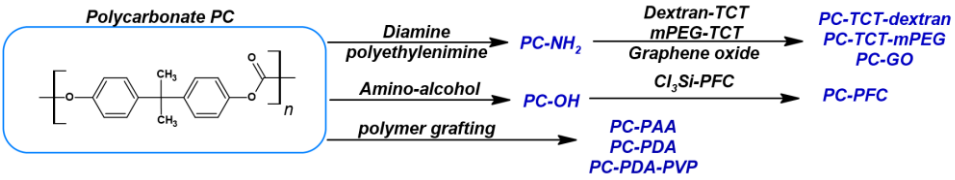

Fig. 1. Chemical routes of polycarbonate (PC) membranes modifications

This work has been supported by Polish National Centre of Research & Development as a part of EuroNanoMed III project (grant number ENM3/IV/1/INTREPIDUS/2021).

Extraction techniques in analysis of secondary drinking water contamination released from plastic water pipes

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Abstract:

The progressive degradation of plastic water pipes during their long-term use can be a source of secondary contaminants released into drinking water. The liberated compounds can significantly degrade the organoleptic parameters of drinking water, and also potentially threaten the health of consumers [1]. The quality and safety of drinking water is regulated by law [2] and strictly controlled in water supply laboratories. Therefore, the selection and optimisation of suitable analytical techniques for the efficient isolation as well as the qualitative and quantitative identification of compounds that constitute secondary drinking water contaminants is crucial.

The purpose of the study was to compare the effectiveness of selected extraction techniques: extraction to solid phase (SPE), headspace (HS-SPME) and direct immersion (DI-SPME) microextraction to environmental samples analysis. The compositions of inflow and outflow water were analysed from a test model constructed from 3 materials: polyethylene (PE) commonly used in water supply networks and two types of polyurea cladding (original material (PM) and after modification (PMN)) with potential application in trenchless water supply network rehabilitation techniques. The compounds extracted from the water were analysed by gas chromatography with a mass spectrometer (Pegasus BT, LECO).

The results showed that the use of SPE, HS-SPME and DI-SPME techniques allows the extraction of a wide range of compounds with different physicochemical properties. The fewest compounds were determined in the treated feed water of the model system. After contact with the test plastics, the number of compounds isolated from water increased significantly. Among the identified analytes, compounds isolated by all techniques as well as those selectively isolated by only one technique were present. The results obtained did not allow the identification of the most universal extraction technique, but it can be concluded that their complementary application allows the efficient isolation and identification of compounds with different characteristics. Therefore, a recommended solution for the analysis of waters of unknown composition is the parallel application of all three extraction techniques.

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MS-DWS technique as a tool for monitoring heat-induced protein denaturation in oil-in-water emulsions

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Abstract:

Proteins are widely used as emulsifiers to facilitate the formation, improve the stability and provide specific physicochemical properties to oil-in-water emulsions. The functional properties of the protein systems depend on the solubility of the biomolecules and their molecular state (native, partially denatured, denatured, aggregated). In many practical applications, it is important to subject protein-stabilized emulsions to thermal treatment, e.g. cooking, pasteurization or sterilization [1]. Protein solubility generally enhances with increasing temperature up to ~50°C, where proteins tend to rearrange their secondary and tertiary structures, resulting in hydrophobic amino acids (e.g., those with free sulfur or thiol groups) becoming available. At higher temperatures, cross-linking between unfolded protein molecules (hydrophobic and electrostatic protein–protein interactions, hydrogen bonds, and sulfhydryl–disulfide exchanges) leads to their aggregation, precipitation, sedimentation, or gelation depending on their thermal stability [2].

Multi-speckle diffusing wave spectroscopy (MS-DWS) is a suitable tool for monitoring heat-induced protein denaturation in oil-in-water emulsions [3]. The optical principle of MS-DWS, enabling sensitivity at the nanometer size, combined with a very accurate temperature control makes it a fast and accurate way to monitor the microstructure evolution in protein stabilized oil-in-water emulsions.

The research was carried out with the use of equipment purchased as part of the "Food and Nutrition Centre - modernisation of the WULS campus to create a Food and Nutrition Research and Development Centre (CŻiŻ)" co-financed by the European Union from the European Regional Development Fund under the Regional Operational Programme of the Mazowieckie Voivodeship for 2014-2020 (Project No. RPMA.01.01.00-14-8276/17).

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Fluorescent molecular probe based on an amide derivative of cumarin and caffeic acid – synthesis and optical analysis

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Abstract:

Fluorescent molecular probes are an identifying group of compounds, which can be used to better understanding of biological systems and the transformations they undergo. They can act as tracers which detect environmental changes due to altering their optical properties [1,2].

On this basis, six-step synthesis was designed and performed to obtain the molecular probe using caffeic acid and an amide derivative of cumarin, which were linked by a diamine linker. The resulting probe was structurally and optically characterised in detail in terms of its fluorescence properties.

The synthesis involved the preparation of two main components, an amide derivative of cumarin and a linker blocked on one side of the amino group. In a further step, the catalysts DIPEA and HATU were employed for the efficient formation of amide bond. A basic raw material was obtained, which reacting with caffeic acid, enabled a fluorescent molecular probe to be obtained. Its detailed fluorescence analysis allowed the determination of a maximum excitation wavelength of 425nm and a maximum emission wavelength of 475nm. Resulting properties of a potential probe can detect iron ions, reactive oxygen species or changes in cell polarity or viscosity, which can take place during biochemical analysis.

HOMING programme by Foundation for Polish Science (agreement no: Homing/2017-4/33)

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Hydrolysis of histones by neutrophil serine protease 4

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Abstract:

Neutrophils, which make up a majority of human white blood cells, play a vital role in defense against infections by various pathogens. They are able to eliminate microbes by utilizing various cellular mechanisms, such as secretion of antimicrobial content of granules, phagocytosis and NETosis. NETosis is a form of programmed inflammatory cell death characteristic to neutrophils and leads to release of NETs- neutrophil extracellular traps [1]. NETs are extracellular DNA structures formed by decondensed chromatin and contain various granular and cytoplasmic proteins which eliminate trapped microbes [1,2]. In the cell nucleus DNA is condensed by wrapping around histones. These rich in basic amino acids proteins are able to interact with negatively charged DNA and form nucleosomes, which are components of more condensed chromatin structures [3].

In order for the NETosis to occur histones must be modified. While it is currently thought that citrullination of histones by PAD4 is the modification responsible for chromatin decondensation in NETs formation, cleavage of histones by neutrophil serine proteases may also play a role in this process. Neutrophil serine proteases (NSPs) including neutrophil elastase (NE), cathepsin G (CG), proteinase 3 (PR3) and neutrophil serine protease 4 (NSP4) are enzymes mainly stored in the primary granules of neutrophils and they hydrolyze peptide bonds between amino acids in many proteins. So far it has been determined that histones may be hydrolyzed by neutrophil elastase and proteinase 3 [2].

Up to this point the role of NSP4 in the cleavage of histones has not been investigated. Therefore we have focus on this in our study and we have determined that histones H1, H2A, H3 and H4 are hydrolyzed by NSP4, however with different potency. We speculate that this may play a role in one of the pathways of neutrophil death.

This work was supported by TEAM NET Programme, a grant project of the Foundation for Polish Science, under agreement No. POIR.04.04.00-00-1603/18.

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Surface modification of titanium implants using ZIF-8 and epigallocatechin gallate for antimicrobial effects and promotion of osseointegration

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Abstract:

This research introduces a surface modification of titanium alloy Ti6Al4V implants aimed at mitigating microbial film formation and enhancing osseointegration process to prevent postoperative infections and improve healing process. The coating consists of Zeolite Imidazolate Framework-8 (ZIF-8), with further modification using epigallocatechin gallate (EGCG). ZIFs exhibit great specific surface area and porosity, which will promote osteoblast adhesion. The synthesis method of such layer was evaluated. The topography and distribution of obtained layer was assessed using SEM, EDS and FT-IR microscopy techniques. Antimicrobial effects are achieved due to the presence of EGCG and Zn^{2+} cations. EGCG and zinc ions are released in a controlled manner from the carrier by ion exchange mechanism in sodium rich bodily fluids [1]. Antimicrobial activity against gram-positive, gram-negative bacteria and *Candida albicans* fungi was determined. Ability to form hydroxyapatite (HAp) crystals on the surface was examined by test conducted in simulated body fluid (SBF) [2]. Size and distribution of HAp was evaluated by FT-IR mapping and EDS mapping. Sorption of proteins to the implant was determined by incubation in bovine serum albumin (BSA) [3]. FT-IR maps were made to show the capability of protein adsorption to the implant. Such materials show great application potential and can lower the risk of bone replacement surgeries.

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A new sample preparation method for peptide biomarker identification in serum samples to discriminate stroke patients

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Abstract:

Stroke ranks second in life threatening disease, only behind cancer. Approximately 80% of these cases are caused by ischemic strokes, a subtype of stroke, where the cerebral artery in the neck is blocked. If not treated fast enough, the function loss can set off a cascade of events, which could lead to irreversible damages, ranging from chronic disease, serious disabilities, to even death. [1] To effectively improve the outcome, it is currently recommended to induce the treatment within the first 4 hours after symptom onset and even here the benefit is increased, the sooner the treatment starts. rtPA (recombinant tissue plasminogen activator) is, at the moment, the only drug approved for treatment of ischemic stroke patients. [2] Despite its benefits of an early treatment and an increase in positive treatment outcomes, administration of rtPA comes with some challenges. The main risk is, that a percentage of patients experience a second stroke, accompanied by brain hemorrhage, where the rtPA treatment appears to be the main contributor to a second, more severe, stroke. [3]

Currently, the lack of an easy-to-use and inexpensive sampling method and lack of an accurate and portable platform to facilitate early disease detection are the major limitations and have seriously hampered the development of clinical diagnostics. A good diagnostic method should have the characteristics of high sensitivity and specificity and meet the requirements of high throughput and low cost for subsequent clinical application all with minimal sample input required. [4] Peptidomics as an emerging field in clinical applications can be used for gathering generous amounts of information on diseases and bodily function as well as identifying possible biomarkers. [5] These biomarkers can be used to identify proper personalized treatment of patients or the best suitable therapeutic method. For example, which patients should not be treated with rtPA to not risk a second stroke.

A major factor in current „omics" research is the sample preparation method as most need a good amount of sample input, are time consuming and lead to a low yield in identified peptides, resulting in a low consistency and reproducibility.

Therefore, we propose a new and innovative sample preparation method, leading to lower amount of input samples needed, a less time consuming experimental setup, while increasing the number of identified peptides and therefore possible biomarker candidates.

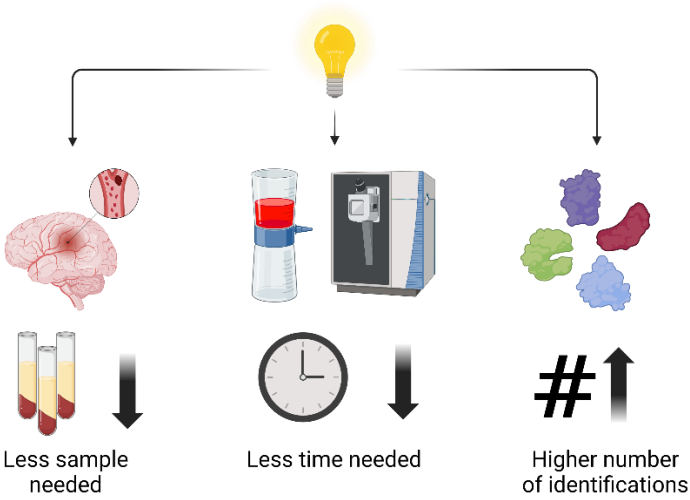

Figure 1.: Schema showing the improvements of the new sample preparation method.

I would like to thank all the scientists and researchers that helped me accomplish the shown results, from all the involved intitutes: The Laboratory of Mass spectrometry of the University of Gdańsk, the neurology department of the Medical University of Gdańsk and the clinical peptidomics group of the International Centre for Cancer Vaccine Research in Gdańsk.

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Hydrosilylation of octaspherosilicate $(HSiMe_2O)_8Si_8O_{12}$ with buta-1,3-diynes

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Abstract:

Octaspherosilicate $(HSiMe_2O)_8Si_8O_{12}$ due to its unique properties, such as cubic, nanometric structure, photochemical and biological properties and ability to functionalization using various methods such as hydrosilylation grants a great research interest ranging from academies to industry [1]. Most papers indicate using octaspherosilicate as a reactive platform for creating hybrid (inorganic-organic) structures and macromolecules. Many applications using spherosilicate focus on preparing liquid crystals [2], electrolytes for lithium batteries, optoelectronic materials [3], and many more.

Functionalizing octaspherosilicate with buta-1,3-diynes is a challenging process as it requires specific catalyst type, concentration of reactants, and temperature, which may be difficult to optimize to get monosubstituted products in high yields.

During the study, new synthetic protocols for selective and efficient monohydrosilylation of symmetrical and non-symmetrical 1,4-distributed buta-1,3-diynes with octaspherosilicate were developed [4]. Additionally, exact reaction times were measured using in-situ FT-IR and the product structure was determined using ^{1}H NMR spectroscopy. All 13 novel products were synthesized with high isolated yields (up to 95%) and were fully characterized using ^{1}H, ^{13}C, ^{29}Si, 1D NOE, ^{1}H-^{13}C HSQC NMR, FT-IR, EA, UV-Vis and MALDI TOF MS. Moreover the thermal stability of products was conducted using TGA analysis, which proved high thermal stability of products – the most stable achieved 5% and 10% weight loss at temperatures as high as 360 and 427˚C.

Financial support from the National Science Centre in Poland No. UMO-2018/31/G/ST4/04012.

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Application of Raman spectroscopy for identification of microplastics in environmental samples

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Abstract:

Microplastics are synthetic, water-insoluble polymers <5 mm in size. They are divided into groups i.a. by colour (coloured and colourless), type of plastic (including polypropylene (PP), polyethylene (PE), polyvinyl chloride (PVC), polystyrene (PS)) and size (microplastics: 5 mm - 1 nm and nanoplastics: <1 nm). MP particles present in the aqueous environment are characterised by different shapes and origins. The most common are particles, fibres, beads, films and foams classified as both primary MP (introduced into the environment already as particles) and secondary MP, released during the degradation of larger objects [1,2]. In the case of tap water, MP particles are the most common unwanted contaminant of raw water feeding into treatment plants. Their presence is also recorded in treated waters leaving treatment plants, indicating that current water treatment technologies are not fully effective. An additional and very important source of MPs in tap water is plastic transmission pipes, which, as a result of the progressive degradation process of their surface, release polymeric particles directly into the transmitted water.

The aim of the research presented here was to test the feasibility of using a portable Raman spectroscope equipped with a laser 785nm in routine studies of microplastics in environmental samples. The material analysed included MP particles isolated from treated water leaving the water treatment plant with dimensions ranging from a few to several tens of micrometres characterised by different shapes and colours. The analysis was carried out using a Raman spectrometer equipped with a video microscope (i-Raman® Plus from BWTek). Spectragryph software was used to analyse the spectra, together with a database available on the software's website containing specifications of the most common microplastics

As a result of the analyses, some of the isolated MPs were identified. Among these, ABS (acrylonitrile-butadiene-styrene terpolymer) particles predominated. The main source of this plastic in water is most likely to be elements of the treatment plant infrastructure used to carry out technological processes.

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Molecular mechanisms of ferroptosis as a therapeutic target

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Abstract:

This review summarises current knowledge of the key mechanisms involved in ferroptosis, such as lipid peroxidation, glutathione peroxidase 4 enzymatic activity and iron metabolism, and evaluates the therapeutic applications of inducing and inhibiting ferroptosis.

Ferroptosis is a specific type of cell death that was described only a decade ago. Ferroptotic cell death is associated with an iron-dependent mechanism and the formation of highly reactive free radicals, as well as strong peroxidation of membrane phospholipids (PLs) rich in polyunsaturated fatty acids (PUFAs), mainly arachidonic acid or adrenergic acid from phosphatidylethanolamine (PE) molecules. It differs morphologically and biochemically from other regulated cell death.

Studies have confirmed that ferroptosis plays an important role in cancer biology and neurodegenerative diseases, among others. This death is regulated by a set of genes and is associated with various metabolic changes. The identification of these genes, the expression of which changes according to the stage of the disease, is crucial for further research, diagnosis and therapeutic implications [1-4].

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Spectroscopic identification of in vitro metabolic changes induced by pyrimidine antimetabolite drugs

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Abstract:

AML (acute myeloid leukemia) arises from somatic mutation sequences within myeloid stem cells. Leukemic blasts undergo transformations resembling self-renewal and differentiation processes seen in stem cells, providing them with a competitive advantage in terms of growth and survival compared to the normal myeloid cell population. This leads to their predominant accumulation within the bone marrow. The disease has a relatively poor prognosis, even with available treatment regimens, which currently involve the elimination of malignant stem and marrow precursor cells (blasts) using cytotoxic agents such as cytarabine.[1] Cytarabine, also known as Ara-C, inserts itself into the DNA chain. This process induces DNA damage, triggering oxidative stress and prompting the activation of cellular defense mechanisms, ultimately culminating in apoptosis.[2]

Raman spectroscopy (RS) is an analytical method that can determine a sample's chemical composition in a label-free and non-destructive way. Integrating RS into hematologic cancer research represents a significant step forward in the diagnostic and treatment monitoring fields.

Using the TEX cell line (AML cell line), Raman imaging, and chemometric multivariate data analysis, we conducted *in vitro* studies to investigate the effects of cytarabine on AML metabolism. Our analysis revealed changes in the spectral profile of the drug-treated TEX cells, indicating alterations in their metabolism. Although cytarabine does not exhibit characteristic bands on the cellular Raman spectrum, our detailed data analysis suggests that the drug is integrated into the structure of nucleic acids. We have also noticed a distinct type of metabolism that is related to the production of reactive oxygen species (ROS).

Acknowledgments: The project "Platform for rapid, label-free imaging, identification, and sorting of leukemia cell subtypes" is being carried out within the Team-Net program of the Foundation for Polish Science (POIR.04.04.00-00-16ED/18-00), co-financed by the European Union from the European Regional Development Fund.

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Nickel(II) complexes as a new catalysts used in the oligomerization process of isocyanides

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Abstract:

Isocyanides, also known as isonitriles, are one of the most reactive groups of compounds in organic chemistry. These compounds have a divalent carbon atom in their structure, to which they attribute their reactivity, and which makes them of great interest in both the scientific and industrial worlds. One of the reactions that isocyanides may undergo is polymerization, and isocyanide-based polymers (IBP's) are used as tumor markers, medical probes, and therapeutic agents, as well as in medicine to produce ointments, synthesize pharmaceuticals and as inhibitors of certain proteins [1,2].

During the study, a series of nickel(II) complex compounds containing organic ligands (e.g., 2,2'-bipyridyl, 1-10-phenanthroline, diglycolate anion) were synthesized, (Fig. 1) and then the complexes were used as catalysts in the oligomerization reaction of cyclohexyl isocyanide.

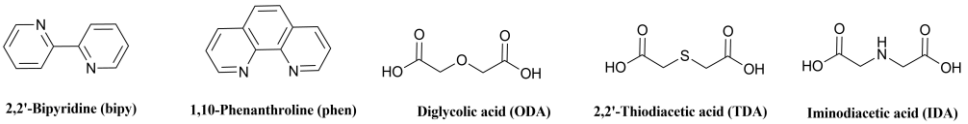

Fig. 1 Organic compounds serving as ligands in the synthesis of nickel(II) complex compounds

The resulting oligomers were characterized by quantitative and qualitative analysis (FT-IR, MALDI-TOF-MS, TGA/DSC, DSC) to confirm their structure and thermal properties. And, based on the weight of the obtained products, the yield of the oligomerization process was calculated. The analyses performed confirmed the structure and physicochemical properties of the obtained products, and the reaction yields settled in the range of 22-94%. The synthesized catalytic systems are new isocyanide oligomerization catalysts not previously described, which successfully led to the synthesis of poly(cyclohexyl isocyanide) with yields ranging from moderate to very satisfactory.

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Removal of selected bisphenol A substitutes using green algae

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Abstract:

Bisphenol A (BPA) is often used as a monomer in the production of epoxy resins, polycarbonate plastics and thermal paper. It can be found in many everyday products, such as food packaging, bottles and containers. Currently, several chemical compounds that are structurally similar to BPA are used to produce plastics. These substances are composed of two hydroxyphenyl functional groups connected by a carbon atom and are defined as its substitutes. However, as many studies indicate, these compounds exhibit similar or much higher toxicity than the parent compound, bisphenol A. Moreover, their presence in the environment may have an adverse effect on the organisms living there. Numerous literature reports confirm the presence of both BPA, as well as its analogues in the aquatic environment and sewage [1,2,3].

The purpose of this study was to conduct an experiment to examine the effectiveness of removing bisphenol A and its selected substitutes, such as bisphenol B and bisphenol Z, from the aquatic environment using green algae *Scenedesmus actus* (BA-24, Culture Collection of Baltic Algae).

The results showed that the green algae *Scenedesmus actus* has a high capacity to remove bisphenol A and its selected substitutes from the aquatic environment. Therefore, during the research, an ecological and effective method of removing these xenobiotics from the aquatic environment was developed.

This project was financially supported by Studenckie Granty Badawcze 2024 at the University of Lodz entitled „Usuwanie wybranych substytutów bisfenolu A za pomocą zielenic”.

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Morphology, surface area and sorption properties of oligomeric materials synthesized using the highly active ruthenium(III) precatalyst

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Abstract:

The field of polymer chemistry is one of the fastest-growing areas of chemistry. Due to the possibility of designing coordination compounds acting as precatalysts, it is possible to modify the structure, dispersibility and thermal properties of the synthesized polymer materials. There is a large research gap in the study of the catalytic activity of coordination compounds in oligomerization reactions of polar monomers. Due to the simplicity of poisoning the active centers by polar functional groups (i.e. -OH), a large group of complex compounds do not show activity in this type of reaction.

The newly synthesised ruthenium(III) coordination compound is innovative due to its thermal stability (up to 388 °C) and very high catalytic activity in the ethylene oligomerization reaction (755.6 g • $mmol^{-1}$ • h^{-1} • bar^{-1} and TON = 10101.1) under mild reaction conditions. The obtaining of ethylene oligomers was confirmed by the determination of the melting point value of the material (Tm = 125.7 °C). The high catalytic properties can be attributed to the increased electron density around the ruthenium(III) cation, which correlates with the presence of 2-phenylpyridine. In addition, the BET and Langmuir specific surface areas, N_2 adsorption and desorption isotherms and pore size and volume of the polymeric materials were determined. Probably due to the highest number of mers, ethylene and allyl alcohol oligomers have the largest surface areas of 168.76 and 124.65 m^2 • g^{-1}, respectively [1].

Project financed by the Ministry of Education and Science under the programme "Pearls of Science" project no. PN/01/0137/2022 (Poland).

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Adsorption of water molecules on the surface of a chemical warfare agent: first-principles theoretical studies of interactions between water and adamsite

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Abstract:

After the Second World War, at least, 40 000 tons of chemical warfare agents (CWAs) were dumped in the Baltic Sea [1]. Unfortunately, hydrolysis and oxidation processes, which were intended to be the best way of a transformation of CWAs into less toxic chemical compounds, are slow, therefore, the dumped CWAs constitute to a real ecological problem nowadays.

Owing to their extreme danger, on site experimental studies of CWAs are very limited, however, the small size of their molecule makes them an ideal target for the theoretical studies and enable a precise description of physicochemical properties of CWAs without the risk of the direct exposure. The aim of our theoretical studies is the fundamental understanding of specific intermolecular interactions between CWA and water molecules, which are crucial to trace the role of the water environment in neutralization of the CWAs after their dumping into the sea.

Our theoretical studies focus on the structural and energetic properties of one of the chemical warfare agents dumped in the Baltic Sea, namely 10-chloro-5,10-dihydrophenarsazinine (diphenylaminechlorarsine) known as adamsite or shortly DM. We study the adsorption of water molecules on the surface of adamsite and formation of intermolecular hydrogen bonds leading to the As-Cl bond elongation and possibly to dissociation. We calculate binding and interaction energies of H2O@Adamsite and analyze different local energy minima of selected adamsite-water molecular clusters.

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Overcoming tumor hypoxia with oxygen mimetic radiosensitizers

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Abstract:

Ionizing radiation can damage DNA directly or indirectly via radiolysis of water. Indirect effect is the dominant pathway, which leads to the formation of reactive oxygen species (ROS), that are able to cause cell damage. A common feature of many solid tumors is oxygen deficiency - hypoxia, which is caused by rapid cancer growth and insufficient angiogenesis. Reduced oxygen level limits the formation of ROS, which contributes to decreasing the number of DNA lesions. Therefore, normoxic healthy cells are up to three times more vulnerable to the harmful effects of radiation than cancer cells, and that remainsa severe limitation of radiotherapy.

The purpose of this presentation is to introduce the idea of oxygen mimetic radiosensitizers - compounds that are able to sensitize cancer cells to ionizing radiation, andare aimed at overcoming tumor hypoxia. Understanding the mechanism of action of such radiosensitizers can help to develop new drugs, which could remarkably improve the effectiveness of radiotherapy in anticancer treatment [1,2].

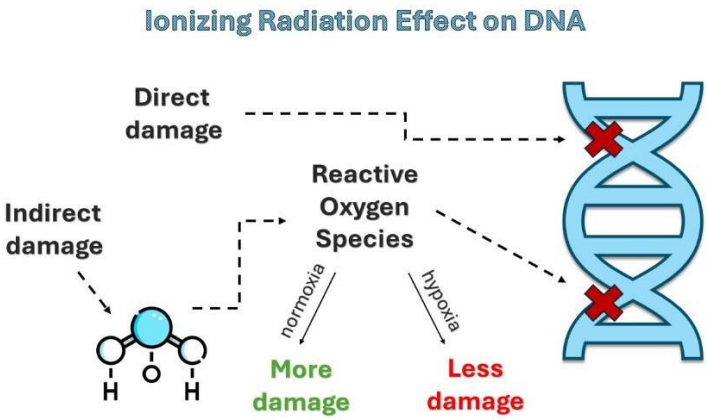

Fig. 1. Direct and indirect ionizing radiation effect on DNA under normoxic and hypoxic conditions.

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PCN-222: A Promising Catalyst for Photocatalytic Applications

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Abstract

PCN-222, a zirconium/porphyrin-based metal-organic framework (MOF), has demonstrated remarkable photocatalytic prowess, notably in CO2 conversion, leveraging its structure's ability to unifylight absorption and charge separation properties. PCN-222 offers tunability through transition metal
variation, enabling band gap modulation for optimized photocatalysis. Noteworthy for its extensiveopen channels, stability, and large specific surface area, it exhibits excellent CO2 adsorption and resilience to photodegradation. Despite synthetic challenges, innovative methods like scalable
continuous flow synthesis show promise for efficient production. In the context of climate change andenergy crises, MOFs like PCN-222 hold significant potential for advancing green fuel production and merit continued research. [1-4]

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Non-steroidal anti-inflammatory drug diclofenac is dangerous forphytoplankton

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Abstract:

Non-steroidal anti-inflammatory drugs, e.g. diclofenac (DCF), belong to contaminants of emerging concern. They can be harmful to non-target organisms, including planktonic green algae [1]. In the present work, diclofenac toxicity towards model green alga Chlamydomonas reinhardtii was investigated.

It was found that DCF disrupts one of the basic physiological processes in the cell, namely mitochondrial respiration. The decrease of mitochondrial membrane potential was visible after just 3 hours of exposure to DCF and deepened over time. To better illustrate the toxic effect of DCF on cells, photographs of the culture were taken using a scanning electron microscope (SEM). This analysis showed that DCF causes significant changes in the structure of cells. The end result of cells exposure to high concentrations of the drug was the death of a large percentage of the population. Our results clearly indicate that non-steroidal anti-inflammatory drugs pose a serious risk for planktonic algae.

Funding: This work was supported by the National Science Centre, Poland [grant number UMO-2021/41/N/NZ8/00124]

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Fluorescent anticancer isothiocyanate derivatives as theranostic tools

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Abstract:

Cancer has been the main cause of death worldwide for many years. This indicates a constant need to explore both the search for new, more effective drugs and improvement of diagnostic tools.

Isothiocyanate derivatives, which are found in brassica vegetables, are an extremely interesting group of compounds fitting into this topic. They are formed after hydrolysis of glucosinolates by the enzyme myrosinase which is present in plant tissues [1].
Sulforaphane is one of the most important and best-studied isothiocyanate, which was discovered as early as 1992 [1]. It has been proven to have anti-cancer effects against different cancers [2].

Fluorescence spectroscopy is recognized as one of the most sensitive techniques that enable the study of biological systems. The main advantages of using the techniques based on fluorescent phenomenon are extremely high sensitivity so the possibility of using low concentrations of compounds and low invasiveness. The introduction of a fluorescent probe into the structure of a compound with anticancer activity significantly expands the range of research techniques used as well as its application potential.

In keeping with this research trend we obtained a series of fluorescently labeled isothiocyanate derivatives. Their selective anticancer effect was verified using PC3 cells (prostate cancer cells), T47D cells (breast cancer cells), and HDFa cells (normal human dermal fibroblast cells). High anticancer activity even at low concentration of compounds (between 1 and 7,5 μM) was observed. Moreover presence of fluorescent probes allows to use these compounds as diagnostic tools. The diagnostic potential of the obtained anti-cancer derivatives was initially determined using cellular models - GUVs liposomes.

Multitasking compounds were obtained. Their structure and properties enable them to be used as theranostic tools combining therapy with diagnostics. Theranostics, which are part of the new trend of personalized medicine, enable therapy to be started during the diagnostic process, therefore these new compounds are a new hope for oncology patients.

Acknowledgements and more

The research was partially funded by the Talents of Tomorrow II grant (Empiria and Knowledge Foundation), no: 61/TJ 2/2023.

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Glycoconjugation of biologically active compounds

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Abstract:

Cancer's diseases are one of the greatest challenges of medicine and one of the leading causes of death in the world today. This is due to the low selectivity of approved chemotherapy drugs, whose use leads to numerous undesirable side effects [1]. Researchers are looking for ways to improve the properties of chemotherapeutic agents by reducing their systemic toxicity and increasing their selectivity profile.

Cancer cells proliferate faster compared to healthy cells and have a different energy metabolism, characterized by a high rate of glycolysis, called the Warburg effect [2]. For this reason, cancer cells have a greater demand for glucose. Therefore, conjugation of a biologically active compound with a sugar molecule should facilitate its transport by GLUT transporters. One can assume that glycoconjugates of biologically active compounds should characterize improved bioavailability, selectivity and pharmacokinetics compared to their parent compounds. From the other side, sugars occurring in numerous combinations with other compounds, forming glycoconjugates located on the surface of cells, where they are responsible for numerous functions, such as intercellular communication and recognition, pathogen adhesion, immune response, and the formation and metastasis of cancer's. Disorders of the glycosylation process generate incorrect exchange of information between cells, which leads to pathogenesis [3]. The enzymes responsible for glycosylation are glycosyltransferases (GTs). Overexpression of enzymes from this group has been observed in many cancers. It is assumed that controlling the activity of these enzymes in cancer cells could contribute to inhibiting carcinogenesis. Compounds capable of inhibiting GTs include, i.a., analogues of their natural substrates, containing a nucleoside fragment in their structure, mainly uridine. This nucleoside is responsible for binding the compound in the active center of these enzymes and closely interacts with the enzymatic protein. Modification of the structures of glycoconjugates containing the uridine fragment may lead to obtaining derivatives with better affinity for these enzymes.

To prove the above assumptions, we obtained glucoconjugates of exemplary biologically active compounds such as uridine and quinoline and tested their cytotoxic effects on cancer cell lines overexpressing GTs and GLUT transporters.

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Antibiotic-resistant bacteria transmission from cemetery soil to the surrounding environment

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Abstract:

Over the years, there has been a notable rise in antibiotic-resistant microorganisms, leading to an increase of antibiotic resistance. Key factors contributing to this problem include the improper use of antibiotics in medical settings, misuse of antimicrobials in animal farming, and the presence of antibiotics in the environment, such as through sewage transmission and cemetery soil, which poses a potential risk of further transmission.

Cemetery soil is known to be a source of contamination with heavy metals or other harmful substances [1], but little is known about its role in antibiotic resistance. Due to insufficient regulations governing burial practices and graveyard management, particularly in locations prone to microbial entry into the environment, notably water bodies, cemeteries might significantly contribute to the proliferation of antibiotic resistance. So far, there have been few studies on this subject [2-3], but they confirm the presence of drug-resistant microorganisms in cemetery soil. Considering bacteria's capability to transmit antimicrobial resistance, these findings are alarming, necessitating further investigation.

My doctoral research focuses on assessing the significance of cemetery soil as a potential reservoir for antibiotic resistance. Soil samples were collected from various cemeteries in the Kuyavian-Pomeranian voivodeship, situated near water reservoirs, including from surface areas and underneath coffins during exhumations, i.e. from the places where the bodies were located, which, due to their nature, may be a source of antibiotic-resistant bacteria and resistance genes.

The samples were screened for bacteria resistant to specific antibiotics (amoxicillin, cefuroxime, doxycycline, and tetracycline) and genes associated with resistance to β-lactams, tetracyclines, and sulfonamides. Variations in resistant colony counts were observed depending on the sampling depth and the resistance genes were registered as well, indicating that cemeteries could indeed serve as sources of antibiotic-resistant bacteria and its genes.

Inappropriate cemetery siting, such as in low-lying areas or near water bodies with high groundwater levels, may exacerbate the spread of antibiotic-resistant microorganisms and their genes from graveyards to the surrounding natural environment. Further research is imperative to fully understand the role of cemeteries in propagating antibiotic resistance.

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Fermented Millet Beverages: A Comprehensive Review on Production, Microbial Dynamics, and Health Benefits

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Abstract:

Fermented foods have been a staple of human diets for thousands of years due to natural form modifications that contribute to high-profile nutritional qualities and better flavor, but little is known about the role that microbes play in these modifications. This work aims to provide a thorough understanding of the beneficial effects of microbes on fermented foods by reviewing the changes in fermented foods that may have an impact on cognition. It does this by providing a detailed overview of the microbial and biochemical changes in fermented foods. Article primarily focuses on different kinds of functional beverages, drinks, instant beverage mixes, with adequate nutritional constituents. Because the effects of fermentation are solely dependent on the metabolic activity of the microbes involved, the impact of various microbe combinations on the content of macronutrients, minerals, and bioactive substances has been examined. [1,2].

The author is sincerely grateful to Lovely Professional University, for necessary support during the work.

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Fruit industry by-products as biofillers for rigid polyurethane foams: material characterization and performance evaluation

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Abstract:

Nowadays, scientists and R&D departments are increasingly looking for innovative, environmentally-friendly solutions that could be implemented in the industry. One way of bringing sustainability into force is to use problematic waste materials, such as fruit stones, for industrial processes. In 2010, global production of all stone fruits amounted to 38.21 million metric tons [1]. This study focuses on a by-product generated by the fruit industry – cherry and plum pits. This waste was tested as a biofiller for rigid polyurethane foams. Polyurethane materials are now used in almost every industry, accounting for 7.9% of total European plastics demand [2]. Hence, the idea of producing such composites on an industrial scale is truly promising [3]. Figure 1 shows how the composites were obtained.

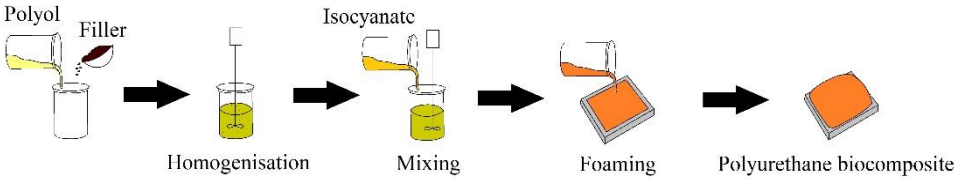

Fig. 1. The process of making a polyurethane biocomposite.

The material was characterised by favourable processing times, excellent filler dispersion, and satisfactory compressive strength and thermal conductivity. This proves that the use of cherry and plum stones as biofillers for polyurethane rigid foams is an excellent way of producing an innovative material with favourable properties.

This research was funded by the Ministry of Science and Higher Education Poland.

Literature:

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Nanoparticles on electric, gas, and diesel buses in mass transit buses of Bogotá, Colombia

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Abstract:

The concentration of traffic-related air pollutants (TRAP) within transport microenvironments has become increasingly relevant in many megacities with high population density, intense traffic, and prolonged travel times. These conditions can intensify exposure to TRAP and exacerbate public health problems. However, TRAP concentrations in these microenvironments are changing due to the introduction of cleaner technologies

In this study, we compared the concentration of nanoparticles inside diesel, gas, and electric buses during their normal operation in Bogota, Colombia. We used a miniature diffusion size classifier (DiSCmini) to measure the nanoparticles' concentrations, average particle size, and lung-deposited surface area. Our results revealed significantly lower levels of this pollutant inside electric buses. Specifically, the concentration of nanoparticles per cubic centimeter was approximately 41% and 27% lower in electric buses compared to diesel and gas buses, respectively. Additionally, the lung-deposited surface area was also lower in electric buses. However, the average particle size in electric buses was 10% and 18% smaller compared to diesel and gas buses, respectively.

The results of this study give useful information for future selection processes of bus technologies for public passenger transport in cities around the world; This research provides information that can be used in technical evaluation processes that link the possible health effects on commuters and impacts the environment [1,2].

Literature:

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Plants as a natural sources of bioactive valuable ingredients useful in cosmetic industry

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Abstract:

For many years, plants have been used as natural and easily available resources in medicine and cosmetology. The extraordinary properties of selected plants can be attributed to a wide range of chemical compounds which are mainly flavonoids, polyphenols, saponins, terpenes, and tannins [1,2]. Due to the growing interest and demand for natural products, the cosmetics industry is constantly looking for new solutions to introduce products with an increased content of plant extracts to the market. Recently, the attention has been focused on applying *Acmella oleracea*, *Centella asiatica*, *Psoralea corylifolia*, *Plantago lanceolata* L., and *Solidago virgaurea* L. Apart from anti-inflammatory and antioxidative activities, the extracts of these plants exhibit promising anti-aging properties, which are valued in modern cosmetology [3]. Additionally, bioactive ingredients present in extracts can replace currently used preparations, such as botulinum toxin, commonly known as Botox. The alternative for it could be spilanthol, which is one of the main active components of *A. oleracea* [4].

In this work we present the properties and applications of selected plants useful for cosmetic and pharmaceutical industries. The composition of extracts and the properties and activities of the main bioactive ingredients, as well as the efficiencies of extraction processes reported in the latest literature have been reviewed.

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Obtaining the lavender absolute

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Abstract:

Lavender absolute is widely used in the cosmetics industry. This product is used in perfumery, soaps, creams and deodorants. It is also used in the household chemicals industry to produce detergents, scented candles and air fresheners. Absolut is an ingredient that gives the appropriate fragrance tones to the final product [1,2].

The demand for plant extracts on the market is constantly growing. This is due to the growing awareness of consumers regarding a healthy lifestyle and natural products. Due to their health-promoting and functional properties, extracts are increasingly used [2,3].

Considering the above aspects, i.e. demand on the cosmetics market, but also in the pharmaceutical and food markets, it was decided to carry out research that involved obtaining lavender absolute, selecting appropriate process conditions, and analyzing the composition of the obtained absolute. Conducting preliminary research was necessary to modernize methods of obtaining and improving production techniques of valuable plant extracts.

The tests were realized using commercial lavender from the narrow-leaved variety (*Lavandula angustifolia*) and ethyl alcohol. The extraction process was executed in a reactor equipped with a heating jacket. Due to the lack of research related to obtaining lavender absolute, a preliminary study was carried out to select appropriate conditions for the extraction process. Optimization of conditions allowed obtaining the best possible process efficiency results. The final stage of the research was to analyze the three main fragrance compounds that constitute the basis of the aroma of lavender absolute by gas chromatograph.

Literature:

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Oximes Metabolism by Pseudomonas Genus Bacteria

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Abstract:

Oximes exhibit recognized properties such as anti-inflammatory effects, relaxation, and diastolic attributes. Recently, their potential as inhibitors of elastase and tyrosine has garnered attention. Elastase and tyrosine are pivotal enzymes implicated in skin aging, rendering oximes valuable in the cosmetics sector[1]. Bacteria belonging to the Pseudomonas genus, inhabiting the human skin, may possess the capability for oxime biotransformation. Consequently, this process could yield skin-aggravating substances, potentially eliciting allergic responses. The objective of this investigation was to assess the biotransformation potential of Pseudomonas fluorescens (ATCC 13525), Pseudomonas putida (ATCC 49128), and Pseudomonas aeruginosa (ATCC 15442) strains concerning the following compounds: p-anisaldehyde oxime, carvone oxime, o-tolualdehyde oxime and (-)-verbenone oxime. (Balcerzak et al. (2019) demonstrated the synthetic protocol for oximes[2].)

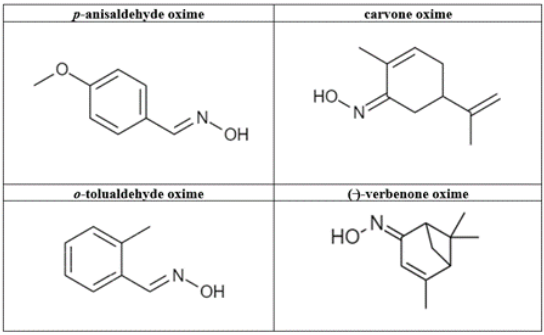

Fig. 1. Structural formulas with the name of the tested compounds

Literature:

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From air to plate

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Abstract:

Food production is entirely dependent on weather and ground conditions. The search for alternatives to agriculture for obtaining food is becoming an increasingly pressing issue. Currently, it is estimated that arable and pasture fields occupy about one-third of the Earth's land area. With a new opportunity comes the company Solar Foods, which has developed the product , Solein.[1]

Solein is , "protein from the air", as it uses carbon dioxide extracted from the air to produce it. It is a product of natural origin, which is extracted from an unmodified, single-celled organism (soil bacteria). Although it is not traditionally cultivated, the product is completely natural, so it can be used in practically every daily meal, while retaining the most necessary nutrients. The micronutrient composition of this product (protein flour) is very similar to that of dried soya or algae. Solein can replace protein in virtually any food or be used as animal feed.[2]

This product appears to be an ideal alternative to the plant protein (e.g. from soy) currently used in vegan products eliminating the aforementioned problems facing modern agriculture.[3]

The presentation will give an overview of the Solein production process. In addition, the benefits that the implementation of this protein ingredient as an alternative source of protein in our diet may bring will be presented.

Literature:

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Awarded speeches

In spite of the high quality of the presentations, we had a difficult task in the selection of the outstanding talks and posters. We would therefore like to extend our sincere congratulations and thanks to the following individuals:

- Catarina Fernandes from the University of Coimbra (VIDEO),
- Joanna Wojtukiewicz from Adam Mickiewicz University in Poznań (LIVE),
- Maciej Piotr Tomaszczak from Poznań University of Technology (Poster),
- Julia Siemieniec from *University of Gdansk* (Poster)

for their excellent work. Thank you for your contributions and inspiration. We look forward to the next edition of this conference and hope for continued participation and memorable events.