XVIII KOPERNIKAŃSKIE SEMINARIUM DOKTORANCKIE

BOOK OF ABSTRACTS

NICOLAUS COPERNICUS UNIVERSITY IN TORUŃ
Faculty of Chemistry

Toruń, 26-27 June 2025

ksd@umk.pl www.ksd.umk.pl

XVIII
Copernican Seminar of Doctoral Students

Faculty of Chemistry
Nicolaus Copernicus University in Toruń

Toruń, 26-27.06.2025 r.

These conference materials were prepared on the basis of abstracts submitted by participants of the XVIII Kopernikańskie Seminarium Doktoranckie.
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CONFERENCE PROGRAMME

THURSDAY (JUNE 26.2025)										
10:15	11:45	REGISTRATION								
11:45	12:05	OPENING CEREMONY (Auditorium I)								
12:05	12:50	CONFERENCE OPENING LECTURE-PROF.DR HAB.ANDRZEJ KOTARBA (Auditorium I)								
12:50	13:30	SPONSORS PRESENTATION (Auditorium I)								
13:30	14:00	COFFE BREAK								
		SECTION OF CHEMICAL SCIENCES			SECTION OF BIOLOGICAL AND MEDICAL SCIENCES			SECTION OF TECHNICAL AND PHYSICAL SCIENCES		
		14:00	14:45	INVITED LECTURE-RNDr. Miloslav Macháček, Ph.D (Auditorium I)						
14:45	15:10	COFFE BREAK								
		15:10	15:55	INVITED LECTURE DR PATRYK JASIK (Auditorium I)	15:10	15:55	I ORAL PRESENTATION SESSIONS (Auditorium II)	15:10	15:55	INVITED LECTURE DR PATRYK JASIK (Auditorium I)
		16:05	17:05	I ORAL PRESENTATION	16:05	16:50	II ORAL PRESENTATION SESSIONS (Auditorium II)	16:10	17:10	I ORAL PRESENTATION SESSIONS (Faculty library)
		17:05	17:45	I POSTER SESSION	17:00	18:00	III ORAL PRESENTATION SESSIONS (Auditorium II)			
19:00	23:00	WELCOME GRILL								

SECTION OF CHEMICAL SCIENCES

ORAL PRESENTATION SESSION

I SESSION THURSDAY 26.06.2025 r. 15:10-16:10			
No.	**Surname**	**Name**	**Title of the speech**
1	Balińska	Natalia	DEVELOPMENT OF A METHOD FOR CHROMATOGRAPHICALLY ANALYSING RISDIPLAM
2	Ostrowska	Karolina	DISPERSIVE SOLID-PHASE EXTRACTION OF ANTISENSE OLIGONUCLEOTIDES USING AMINO ACID-BASED ADSORBENTS
3	Grzegórska	Magdalena	INVESTIGATING SYMMETRIC POLYSULFONATE POLYAROMATIC UREA COMPOUNDS AS A POTENTIAL INHIBITORS OF GUANYLATE KINASE FROM *MYCOBACTERIUM TUBERCULOSIS*
4	Morawska	Karolina	DEVELOPMENT OF AN ELECTROCHEMICAL BIOSENSOR FOR SPECIFIC DETECTION OF BACILLUS ANTHRACIS SPORES USING ANTIBODY–ANTIGEN IMMUNOREACTION

II SESSION FRIDAY 27.06.2025 r. 9:45-10:45			
No.	**Surname**	**Name**	**Title of the speech**
1	Wujcicki	Łukasz	ION IMPRINTING TECHNOLOGY VS CHITOSAN - A NEW ERA IN REMOVAL OF POLLUTION AND RECOVERY OF METALS FROM WASTEWATER
2	Afandi	Karima	PREPARATION AND CHARACTERIZATION OF ALGINATE-BASED FILMS CONTAINING EPILOBIUM PARVIFLORUM, TANACETUM VULGARE, AND FILIPENDULA ULMARIA EXTRACTS FOR POTENTIAL TOPICAL APPLICATION IN ACNE ROSACEA
3	Walendziak	Weronika	FREEZE-DRIED EMULSION AND BIGEL SYSTEMS: NOVEL ECO-CONSCIOUS MATERIALS FOR COSMETIC APPLICATIONS
4	Świerkula	Aleksandra	AAO LAYERS WITH COMPLEX CHANNELS GEOMETRY OBTAINING BY MODIFYING THE ANODIZATION CONDITIONS

III SESSION FRIDAY 27.06.2025r. 11:15-13:00			
No.	**Surname**	**Name**	**Title of the speech**
1	Kądziałka	Patrycja	INFLUENCE OF STRUCTURE ON PROTON CONDUCTIVITY OF ORGANIC SKELETONS WITH HYDROGEN BONDING
2	Parzych	Cezary	IN SILICO ANALYSIS OF POTENTIAL ANTICANCER ACTIVITY OF THIAZOLE DERIVATIVES
3	Chuchracka	Klaudia	DYNAMIC INDUCTION OF OPTICAL ACTIVITY IN CHROMOPHORIC SYSTEMS WITH INCREASING STERIC HINDRANCE
4	Wiatr	Monika	SUBSTITUENT AND SOLVENT EFFECTS ON THE PHOTOPHYSICAL PROPERTIES OF BF_2-CONTAINING FLUOROPHORES – A QUANTUM CHEMICAL STUDY
5	Cichocka	Julia	THE EFFECT OF A SUGAR ADDITIVE ON THERMAL PROPERTIES, PHYSICAL STABILITY, AND AQUEOUS SOLUBILITY OF ENZALUTAMIDE
6	Kukawka	Rafał	AN ALTERNATIVE APPROACH TO PLANT PROTECTION USING NOVEL IONIC DERIVATIVES OF SALICYLIC ACID
7	Okła	Karol	BIOLOGICAL ACTIVITY OF IRIDIUM(III) COMPLEXES WITH CYCLOMETALATING PYRAZOLE DERIVATIVE

POSTER SESSION

I SESSION THURSDAY 26.06.2025 r. 16:10-17:10			
No.	**Surname**	**Name**	**Title of the speech**
1	Rokk	Siva Kumar	DEVELOPMENT OF NOVEL CURCUMIN-POLYPHENOL CONJUGATES AS POTENTIAL BLADDER CANCER AGENTS
2	Kowalska	Agata	CORE-SHELL NANOSTRUCTURES AS INNOVATIVE NANOCARRIERS IN DRUG DELIVERY SYSTEMS
3	Fijałkowski	Paweł	LACTOFERRIN AS A CARRIER FOR CISPLATIN: SYNTHESIS, PHYSICOCHEMICAL CHARACTERIZATION, AND CYTOTOXICITY ASSESSMENT IN TARGETED CANCER THERAPY
4	Szyk	Piotr	POLOXAMER FUNCTIONALIZED WITH GALACTOSE AND DRUGS FOR TARGETED THERAPY OF PRIMARY LIVER CANCERS
5	Czaja	Kacper	MOLECULAR TAXIS FOR DRUGS – INCLUSION COMPLEXES OF β-CYCLODEXTRIN WITH SELECTED ANTIASTHMATIC AGENTS
6	George Raju	Silla	POLYLACTIDE / HALLOYSITE NANOCLAY / POLYTETRAFLUOROETHYLENE NANOCOMPOSITES FOR FOAMING
7	Chornovolenko	Kyrylo	PHOTODYNAMIC THERAPY: NOVEL PORPHYRAZINE DERIVATIVES WITH POTENTIAL ANTI-TUMOR ACTIVITY -SYNTHESIS AND OPTICAL CHARACTERIZATION
8	Gierczak	Natalia	ANALYSIS OF NEW COORDINATION COMBINATIONS OF S-BLOCK METALS WITH SELECTED NONSTEROIDAL ANTI-INFLAMMATORY DRUGS
9	Khelassi	Nechoua Lina	ENHANCING ANTIOXIDANT ACTIVITY OF ALGERIAN ENDEMIC PLANT EXTRACTS VIA WHEY PROTEIN ENCAPSULATION
10	Wasicki	Miłosz	UNLOCKING THE POTENTIAL OF FERMENTED FOOD EXTRACTS: FATTY ACIDS AND MINERALS PROFILING
11	Trocka	Alicja	THIOAMIDE-FUNCTIONALIZED TETRAHYDROCARAZOLES AS POTENTIAL ANTICANCER AGENTS
12	Nowicka	Paulina	FROM STRUCTURE TO FUNCTION: CADMIUM(II) COORDINATION CONNECTIONS CONTAINING IMIDAZOLE IN THE STRUCTURE AS SELECTIVE ANTIFUNGAL AGENTS

II SESSION FRIDAY 27.06.2025 r. 14:00-14:45			
No.	**Surname**	**Name**	**Title of the speech**
1	Kowalska	Sylwia	DETERMINATION OF SELECTED BIOGENIC AMINES AND THEIR PRECURSORS IN POULTRY MEAT PROTECTED BY CHITOSAN FILM
2	Kowalska	Sylwia	SYNTHESIS OF NEW CARBAMATES DERIVED FROM BIOGENIC AMINES AND AMINO ACIDS FOR APPLICATIONS IN FOOD ANALYSIS AND COSMETICS
3	Moskwa	Paulina	INFLUENCE OF SUBSTITUTES OF PYRAZOLOQUINOLINE DERIVATIVES ON THEIR SPECTROSCOPIC AND SENSORY PROPERTIES
4	Rudzik	Paulina	APPLICATION OF TITANIUM DIOXIDE AND Ag/TIO2 AND PLASMONIC NANOCOMPOSITES IN LASER DESORPTION IONIZATION (LDI) TECHNIQUES
5	Adamczyk	Magda	FLUORESCENT DYES BASED ON PERYLENE STRUCTURE
6	Dunal	Anna	CHEMO-ENZYMATIC SYNTHESIS OF 10-KETOSTEARIC ACID FROM OLEIC ACID
7	Błaszczyk	Wiktoria	EFFICIENT REMOVAL OF POTENTIALLY TOXIC ELEMENTS FROM DIGESTED SEWAGE SLUDGES USING PROTIC IONIC LIQUIDS
8	Hromova	Anna	TARGETING THE NMD PATHWAY: DESIGN AND SYNTHESIS OF 1,3-DISUBSTITUTED UREAS AS NOVEL INHIBITORS OF THE UPF1
9	Jaros	Marta	NEW COMPLEXES OF NICKEL(II) AS POTENTIAL PRECURSORS FOR VAPOUR DEPOSITION METHODS
10	Schab	Patrycja	SYNTHESIS AND ANALYSIS OF METAL COMPLEXES WITH FLUFENAMIC ACID
11	Tiwari	Mohit Kumar	DESIGN, SYNTHESIS AND BIOASSESSMENT OF FUNCTIONALISED MONO-SPIRO-1,2,4,5-TETRAOXANES
12	Olewniczak	Michał	MECHANISM OF ALLOSTERIC ACTIVATION OF HSP70: ATP HYDROLYSIS-INDUCED CONFORMATIONAL CHANGES
13	Fijałkowski	Piotr	INVESTIGATION OF THE MECHANISM, NATURE, AND PROPERTIES OF IRON(III) ION BINDING TO OVOTRANFERRIN (OTF). BIOLOGICAL ACTIVITY OF THE FE-OTF COMPLEX
14	Jahani	Seyedeh Arasteh	INFLUENCE OF POLYMER MATRICES ON PHOTOPHYSICAL PROPERTIES OF AZODYES THIN FILMS
15	Piotrowska	Aleksandra	STUDY OF THE COMPOSITION AND STRUCTURE OF DX51D SHEET METAL USING SCANNING ELECTRON MICROSCOPY (SEM)

SECTION OF BIOLOGICAL AND MEDICAL SCIENCES

ORAL PRESENTATION SESSION

I SESSION THURSDAY 26.06.2025 r. 15:10-15:55			
No.	**Surname**	**Name**	**Title of the speech**
1	Szupryczyński	Kamil	COULD AROMATIC COMPOUNDS RIVAL DNA NUCLEOBASES IN PLATINUM-BASED ANTICANCER THERAPY? EVALUATING BINDING COMPETITION AND TREATMENT IMPLICATIONS
2	Zawadzka	Aleksandra	BIOCOMPATIBILITY OF POLYMERIC MEMBRANES FOR WOUND DRESSING - IN VITRO STUDY
3	Bagińska	Zofia	EVALUATION OF THE BARRIER PERFORMANCE OF COMPONENTS PRESENT IN OROMUCOSAL PREPARATIONS

II SESSION THURSDAY 26.06.2025 r. 16:05-16:50			
No.	**Surname**	**Name**	**Title of the speech**
1	Kawecka	Paulina	FEEDING DISORDERS IN CHILDREN AND THE RISK OF MALNUTRITION AND DIET-RELATED NON-COMMUNICABLE DISEASES
2	Górzyńska	Aleksandra	WHICH DIETARY SUPPLEMENT CONTAINING SACCHAROMYCES BOULARDII IS BEST TO USE? AN EVALUATION OF PROBIOTIC PRODUCTS AVAILABLE IN PHARMACIES
3	Dydak	Karolina	MICROBIOLOGICAL ASSESSMENT OF PROBIOTIC PRODUCTS: QUALITY AND CONTAMINANT ANALYSIS

III SESSION THURSDAY 26.06.2025 r. 17:00-18:00			
No.	**Surname**	**Name**	**Title of the speech**
1	Grzeczka	Paulina	NEXT-GEN PLANT-BASED FOODS: PHYSICOCHEMICAL AND MOLECULAR EVALUATION OF VEGAN PÂTÉS
2	Kannenberg-Leszczyńska	Dorota	CHLOROPLAST INSERTIONS IN PLANT NUCLEAR GENOMES
3	Robak	Dominika	REGENERATION STRATEGY OF BLACK POPLAR (POPULUS NIGRA L.) ALONG THE VISTULA RIVER
4	Terlecka	Magdalena	BETWEEN CLONES AND SEXES: THE ROLE OF DIOECY AND CLONALITY IN SHAPING SPATIAL GENETIC STRUCTURE IN POPULUS ALBA L.

IV SESSION FRIDAY 27.06.2025 r. 9:00-10:45			
No.	**Surname**	**Name**	**Title of the speech**
1	Klochowicz	Dominika	ASSESSMENT OF THE SUSCEPTIBILITY OF CLAVISPORA LUSITANIAE (SYN. CANDIDA LUSITANIAE) TO MANOGEPIX AND AMPHOTERICIN B
2	Pucek	Julia	SUSCEPTIBILITY TO MANOGEPIX AND ISAVUCONAZOLE OF REPRESENTATIVES OF PICHIA CACTOPHILA SPECIES COMPLEX
3	Korczak	Łukasz	THE ROLE OF SUBINHIBITORY CONCENTRATIONS OF TIGECYCLINE IN MODULATING THE EXPRESSION OF EFFLUX AND REGULATORY GENES IN ENTEROBACTER CLOACAE COMPLEX STRAINS
4	Huse-Kutowska	Monika	VIRULENCE GENES IN ENTEROCOCCUS SPP. ISOLATED FROM WASTEWATER TREATMENT PLANTS
5	Konopińska	Natalia	TACHYKININ-RELATED PEPTIDES AS REGULATORS OF THE REPRODUCTIVE SYSTEM IN FEMALE TENEBRIO MOLITOR L. – A POTENTIAL TOOL IN INSECT REARING AND PLANT PROTECTION
6	Dudek	Gracjan	EFFECTS OF GLYCOALKALOIDS ON THE RETROCEREBRAL COMPLEX IN TENEBRIO MOLITOR BEETLE
7	Lewandowska-Wosik	Anetta	BIOLOGICAL EFFECTS OF LONG-TERM EXPOSURE OF DROSOPHILA MELANOGASTER AND D. SUZUKII TO SUBLETHAL DOSES OF THE NEONICOTINOID ACETAMIPRID

V SESSION FRIDAY 27.06.2025 r. 12:00-13:00			
No.	**Surname**	**Name**	**Title of the speech**
1	Pilarska	Gabriela	ANALYSIS OF MYCOTOXINS IN BIOLOGICAL SAMPLES FROM WOMEN WITH ENDOCRINE DISORDERS
2	Ibrahim	Rim	EXPLORING GENETIC VARIANTS IN ASTHENOZOOSPERMIA: NEW FINDINGS FROM CONSANGUINEOUS FAMILIES
3	Pietras	Maja	INFLUENCE OF BODY COMPOSITION ON ACOUSTIC VOICE CHARACTERISTICS IN A GROUP OF PERI- AND POSTMENOPAUSAL WOMEN
4	Zacharczuk	Julia	EVALUATING DNA PRESERVATION IN HUMAN SKELETAL REMAINS FROM STALAG IID: A COMPARATIVE STUDY

VI SESSION FRIDAY 27.06.2025 r. 14:00-14:45			
No.	**Surname**	**Name**	**Title of the speech**
1	Maślanko	Marta	THE INFLUENCE OF STRESS-INDUCING FACTORS ON THE VIABILITY OF MURINE FIBROBLAST L929 CELL LINE
2	Kruszyńska	Angelika	POTENTIAL MECHANISM OF LYMPHOID CELL DEATH INDUCED BY ANTI-MHC II ANTIBODIES
3	Chmura	Weronika	ANALYSIS OF POLYP AND DNA INTERACTIONS WITH SELECTED PROTEINS

POSTER SESSION

I SESSION FRIDAY 27.06.2025 r. 11:15-12:00			
No.	**Surname**	**Name**	**Title of the speech**
1	Kulus	Ilona	PHOSPHORUS NUTRITION AS A REGULATOR OF OAT VARIETES (AVENA SATIVA) GROWTH AND PHOTOSYNTHETIC APPARATUS ACTIVITY
2	Kwiatkowska-Giżyńska	Justyna	EFFECT ON MOULDS GROWTH AND MYCOTOXIN PRODUCTION BY PLANT EXTRACTS
3	Pudełek	Maciej	MITOFUSIN 2 DEPENDENT MITOCHONDRIAL FUSION AND ENHANCED GLUTAMINE METABOLISM DRIVE GLIOMA CELLS ADAPTATION TO DOXORUBICIN INDUCED STRESS
4	Szlauer	Wojciech	QUATERNARY AMMONIUM SALTS IN HEALTHCARE - ANTIMICROBIAL ACTIVITY OF NEWLY SYNTHESIZED CATIONIC SURFACTANTS
5	Suhartoyo	Aji	DESIGN AND FABRICATION OF BIOCOMPOSITE SPONGES BASED ON GELLAN GUM/MUSA SAPIENTUM/CUCURBITA MAXIMA FOR SUSTAINABLE WOUND DRESSINGS
6	Nagórka	Michalina	THE INFLUENCE OF Dr FIMBRIAE ON THE ADHESION OF ESCHERICHIA COLI/Dr+ STRAINS TO ABIOTIC SURFACES AND KIDNEY STONE COMPONENTS AT VARIABLE pH
7	Lipa	Wojciech	ECHOES OF ANCESTRY: HISTORICAL HYBRIDIZATION AND INTROGRESSION IN EURASIAN WILD BOAR (SUS SCROFA L., 1758) POPULATIONS
8	Cierpisz	Patryk	THE ROLE OF THE HMU SYSTEM IN PIGMENT FORMATION IN PORPHYROMONAS GINGIVALIS
9	Juszczak	Aleksandra	EVALUATION OF THE PROPERTIES OF DERMOCOSMETICS WITH POTENTIAL USE FOR SKIN CARE OF PATIENTS TREATED WITH RADIATION THERAPY OF THE HEAD AND NECK CANCERS
10	Gajewska	Sandra	DISCOVERY OF THE FIRST AK4 INHIBITORS USING HIGH-THROUGHPUT SCREENING OF A STRUCTURALLY DIVERSE COMPOUND LIBRARY
11	Piórkowska	Wiktoria	NEUROPROTECTIVE PROPERTIES OF CAFFEINE AND NARINGIN IN A SH-SY5Y LINEAGE-BASED MODEL OF PARKINSON'S DISEASE
12	Mazurkiewicz	Edyta	CATIONIC SURFACTANTS IN THE FIGHT AGAINST MICROBIAL RESISTANCE
13	Kozerska	Karolina	CHITOSAN COMPOSITES CROSSLINKED WITH HEMOGLOBIN AND BOVINE SERUM ALBUMIN WITH THE ADDITION OF BODIPY AS POTENTIAL MATERIALS FOR APPLICATION IN PDT
14	Gwiazda	Daria	MATERIALS BASED ON POLYSACCHARIDES ENRICHED WITH PLANT EXTRACT AS POTENTIAL WOUND DRESSINGS
15	Kozlikova	Magdalena	2D AND 3D TUMOR MODELS: APPLICATION TO DETERMINE THE PHOTODYNAMIC ACTIVITY OF THE ORIGINAL PHTHALOCYANINES

16	Krasocka	Weronika	EVALUATION OF THE EFFECT OF VANILLIC ACID ON THE FUNCTIONS OF HUMAN IMMUNE CELLS AND ITS PROTECTIVE PROPERTIES TOWARDS HUMAN PLASMA COMPONENTS
17	Magiera	Anna	OPTIMISATION OF EXTRACTION AND PHYTOCHEMICAL PROFILING OF THE DRY EXTRACT OF PRUNUS PADUS L. BARK
18	Skrzydlewski	Paweł	ANALYSIS OF MYCOTOXINS AND CORTISOL LEVELS IN TISSUES OF WILD BOARS
19	Smolarkiewicz-Wyczachowski	Aleksander	BIOCOMPATIBLE CHITOSAN/KEFIRAN-BASED WOUND DRESSINGS CROSSLINKED WITH DIALDEHYDE KEFIRAN AND ENRICHED WITH HENOLA EXTRACTS
20	Tkacz	Zuzanna	POLYSACCHARIDE-BASED DRESSING SPONGES ENRICHED WITH CLITORIA TERNATEA EXTRACT AND PAPAIN NANOSTRUCTURES AS POTENTIAL SUPPORT IN BATTLEFIELD AND EMERGENCY MEDICAL CARE
21	Zbaranskaya	Alina	BIOMATERIALS CROSSLINKED WITH DIALDEHYDE INULIN AND ENRICHED WITH PLANT EXTRACT AS POTENTIAL WOUND DRESSING MATERIALS

SECTION OF PHYSICAL AND TECHNICAL SCIENCES

ORAL PRESENTATION SESSION

I SESSION THURSDAY 26.06.2024 r. 15:10-16:10			
No.	**Name**	**Surname**	**Title of the speech**
1	Krawczyk	Artur	STRESS TENSOR FROM TRACE ANOMALIES
2	Olejarczyk	Paweł	DYNAMIC OPTICAL TRAPPING OF HYDROGEN MOLECULES IN A CRYOGENIC REGIME
3	Rudnicka	Zofia	HYPERPARAMETER OPTIMIZATION AND COMPARATIVE EVALUATION OF LEARNING ALGORITHMS FOR SPIKING NEURAL NETWORKS ON MNIST: A STUDY OF ANN-TO-SNN CONVERSION, SURROGATE GRADIENT BACKPROPAGATION, AND TEMPOTRON LEARNING
4	Vasantha Kumar	Kathirvelu	EYE IN MOTION: MAPPING OCULAR PULSATION WITH SS-OCT

II SESSION FRIDAY 27.06.2024 r. 10:00-10:45			
No.	**Name**	**Surname**	**Title of the speech**
1	Chuchała	Patrycja	SURVIVAL AND METABOLIC RESPONSE OF GLIOMA CELLS TO FLASH IRRADIATION: PRELIMINARY RESULTS FROM SF AND MTT ASSAYS
2	Murzyn	Aleksandra	EPR IMAGING AS A TOOL FOR QUANTITATIVE ASSESSMENT OF TUMOR TISSUE OXYGENATION IN VIVO
3	Gloc	Martyna	PHARMACEUTICAL CONTAMINANTS IN WASTEWATER: RISK ASSESSMENT AND BIODEGRADATION APPROACHES

III SESSION FRIDAY 27.06.2024 r. 11:15-13:00			
No.	**Name**	**Surname**	**Title of the speech**
1	Piotrowska	Aleksandra	ASSESSMENT OF THE FLAMMABILITY AND SMOKE EMISSION OF FLEXIBLE POLYURETHANE FOAMS DERIVED FROM A GREEN BIO-POLYOL
2	Domińska	Marlena	DARK FERMENTATION OF STARCH-BASED EFFLUENTS FOR HYDROGEN PRODUCTION
3	Kaczor	Daniel	BIODEGRADABLE COMPOSITES WITH CARBON NANOTUBES OBTAINED BY EXTRUSION
4	Grabiec	Radosław	ON STRAIN-RATE DEPENDENT MECHANICAL RESPONSE OF ADDITIVELY MANUFACTURED INCONEL 625 ALLOY
5	Eid	Mohanad	HALIDE PEROVSKITE SINGLE CRYSTALS AS EMERGING SCINTILLATORS FOR RADIATION DETECTION APPLICATIONS
6	Mientki	Mateusz	FABRICATION AND CHARACTERIZATION OF PROTOTYPE SOLAR CELLS BASED ON PEROVSKITE
7	Ziółkowski	Przemysław	ELECTROCHEMICAL PROPERTIES OF CARBON NANOTUBES AND GRAPHENE DECORATED WITH NANODIAMONDS

INAUGURAL LECTURE

Prof. dr hab. Andrzej Kotarba

FACULTY OF CHEMISTRY, JAGIELLONIAN UNIVERSITY

LECTURE TITLE: KAROL OLSZEWSKI - A LIFE DEDICATED TO CHEMISTRY

KAROL OLSZEWSKI: THE LIFE AND SCIENTIFIC LEGACY

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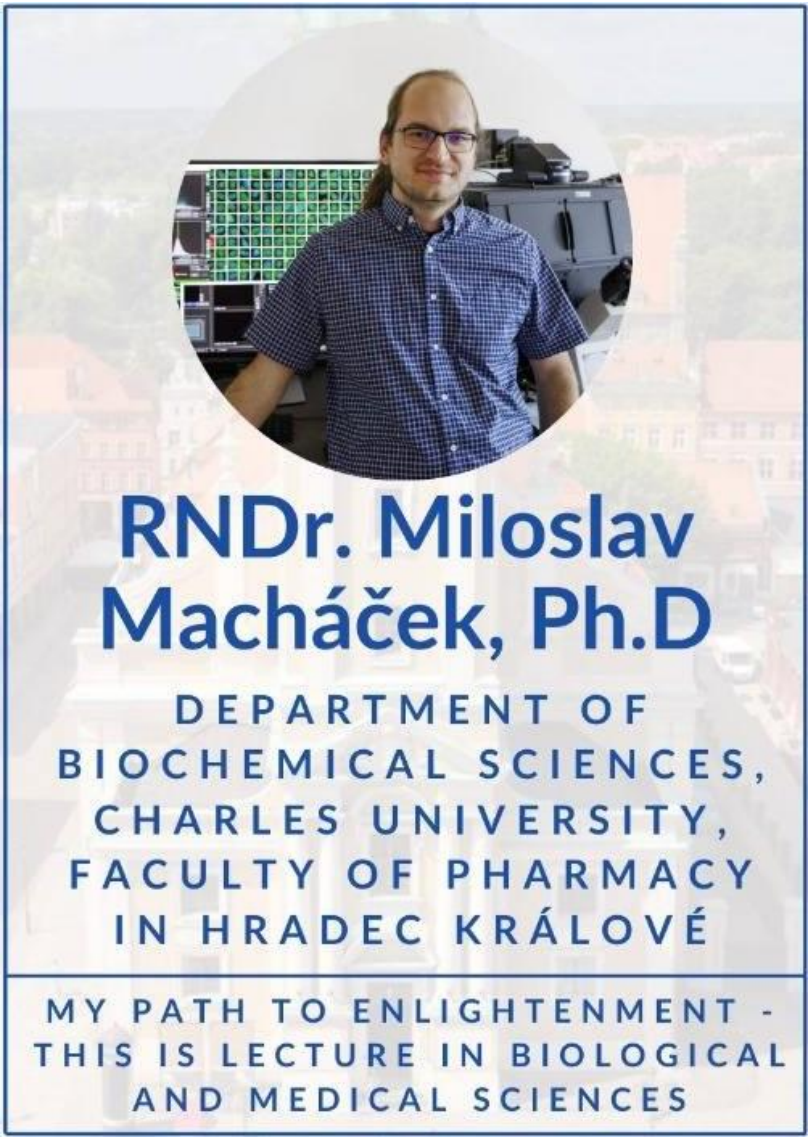
In this lecture, we explore the remarkable life and scientific contributions of Karol Olszewski, a distinguished professor at Jagiellonian University, one of Poland's greatest pioneers in science. We begin with his youth years: his early adventures, university studies at the Jagiellonian University, and initial research on the water quality of Kraków wells. We will then follow his collaborations with eminent scientists such as Robert Bunsen, Gustav Kirchhoff, and Zygmunt Wróblewski. Central to the lecture is Olszewski's groundbreaking work in liquefying air components, his innovations in cryogenic apparatus, and the first X-ray image ever taken in Poland. Beyond his scientific achievements, we look at Olszewski the man: a skater, cyclist, mountain hiker, gardener, and a citizen of Krakow. The lecture concludes by reflecting on the lasting impact of his works, from the cold pole of cryogenic research to the iconic portrait by Leon Wyczółkowski that captured his spirit.

PLENARY LECTURE

SECTION OF CHEMICAL SCIENCES
SECTION OF BIOLOGICAL AND MEDICAL SCIENCES
SECTION OF PHYSICAL AND TECHNICAL SCIENCE



MY PATH TO ENLIGHTEMENT

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Ligh has been used to treat various medical conditions since the dawn of civilisation – e.g., thousands of years ago sunlight was used to treat vitiligo in antient Egypt using plant extracts. Similar reports were found in India, China, Greece… Modern light-based therapies (including photodynamic therapy (PDT) or photochemical internalization (PCI)), build on the foundations laid more than a century ago by several scientists like Hermann von Tappeiner ("photodynamic effect" of acridine on *Paramecium* sp.) or Nils Ryberg Finsen (UV therapy of *lupus vulgaris* by "Finsen lamp") [1-2].

In our group we are focused on development of novel phthalocyanine-based photosensitizers (including aza- and subphthalocyanines) suitable for photodynamic therapy. Phthalocyanines are synthetic analogues of porphyrins with strong Q-band around 650-800 nm allowing the use of light with deeper penetration into the tissues. On the other hand, planar lipophilic core aggregate in water-based environments leading to the loss of activity [3]. Novel zinc(II) phthalocyanine (Pc) derivatives designed and synthesized in our group overcome this issue by suitable peripheral substitution leading to perfect monomerization in biologically relevant media. But is it necessary? Both answers are correct. It depends on the application! Our symmetrical cationic derivatives proved to be superior photosensitizers for PDT of cancer in both *in vitro* (with EC_{50} in nanomolar range [4]) and *in vivo* environment (mouse tumour model). But these derivatives are basically useless in PCI or light-induced drug release from liposomes – here amphiphilic derivatives are known to be the best choice (even considering their aggregated state in water).

But cancer is not the only target for PDT. Great opportunity lies in overcoming antimicrobial resistance using alternative treatment modalities – such as antimicrobial PDT. Here, cationic PSs are known to be more efficient in microbial killing in comparison to neutral and anionic. More complex and thicker cell membrane of Gram– bacteria pose a challenge for PS design. Usually, polycationic PSs are more suitable for G– bacteria eradication while cationic, anionic or non-charged PSs can be all utilized against G+ bacteria. Most of this research was conducted on porphyrins. Our data suggest that this might not apply to Pc-based PSs – at least not in general. Our results demonstrate superior activity of amphiphilic derivatives (2 charges) over hydrophilic polycationic ones in variety of microorganisms including those hidden in the acronym ESKAPE while potentially remaining safe for the host.

Acknowledgments:
Supported by Ministry of Health of the Czech Republic, grant nr. NW24J-05-00016.

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PLENARY LECTURE

SECTION OF CHEMICAL SCIENCE
SECTION OF PHYSICAL AND TECHNICAL SCIENCES

BIOPHYSICAL AND BIOCHEMICAL DATA AS FUEL FOR ARTIFICIAL INTELLIGENCE MODELS

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„Data is the new oil” **„AI is the new electricity”**

It is widely recognised that human civilisation is generating vast amounts of data from numerous sources today. These data are used across virtually every aspect of our lives, sometimes for good intentions, sometimes for bad ones. Amid the ongoing technological revolution, where artificial intelligence methods underpin new products and tools, data has become a kind of currency. But should this also apply to biophysical and biochemical data, information derived directly from the human body? In this lecture, I will discuss why we should democratize access to biophysical and biochemical data, using three AI-based solutions as case studies.

Predicting the Risk of Intracranial Aneurysms

The goal of this research is to assess the likelihood that a patient belongs to a high-risk group for developing intracranial aneurysms and to identify factors that predispose these aneurysms to rupture, based on clinical data analysis. We use a range of machine learning (ML) and artificial intelligence (AI) models, including large language models, to develop a classification system and a medical risk calculator for aneurysm detection. By employing explainable AI methods, we gain insight into the decision-making processes of these models, which enhances our understanding of machine-generated diagnoses. Ultimately, this research aims to develop diagnostic tools that could reduce mortality, hospitalization costs, and neurological complications in patients with intracranial aneurysms.

Assessing Malignancy Probability of Renal Tumors from CT Images

Renal cell carcinoma is among the most common cancers in Europe, with an incidence rate of 18.4 cases per 100,000 people. Radiological studies often lead to significant overdiagnosis (ranging from 11% to 30.9%) at the time of planned surgery. In this study, we present a method for creating an ML/AI solution based on computed tomography (CT) imaging to support the differentiation of malignant and benign renal tumours, thereby aiding in decisions regarding active surveillance.

Recognising Human Emotional States Using EEG Signals

This study presents a machine learning approach to recognising human emotional states using EEG signals. We combine electroencephalography and neural oscillations with Russell's two-dimensional valence-arousal model of emotions. We present the design of an EEG-based experiment and describe key aspects of data sanitisation, including preprocessing, feature extraction, and target variable generation. At the modeling stage, multiple classifiers were developed to benchmark performance in emotion recognition. Our approach demonstrated that it is possible to accurately classify human emotional states using ML, achieving accuracy rates exceeding 90%

SECTION OF CHEMICAL SCIENCES
ORAL PRESENTATIONS

PREPARATION AND CHARACTERIZATION OF ALGINATE-BASED FILMS CONTAINING *EPILOBIUM PARVIFLORUM*, *TANACETUM VULGARE*, AND *FILIPENDULA ULMARIA* EXTRACTS FOR POTENTIAL TOPICAL APPLICATION IN ACNE ROSACEA

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Rosacea is a chronic inflammatory skin disorder primarily affecting the facial region, characterized by redness, visible blood vessels, and in some cases, acne-like pustules. While its exact etiology remains unclear, factors such as oxidative stress, abnormal immune responses, and skin barrier dysfunction are believed to contribute to its pathogenesis [1]. Conventional treatments often include antibiotics and anti-inflammatory agents, but they may cause side effects or resistance over time. There is growing interest in natural, plant-based alternatives due to their antioxidant, anti-inflammatory, and antimicrobial properties [2]. Herbs such as *Epilobium parviflorum* (hoary willowherb), *Tanacetum vulgare*, and *Filipendula ulmaria* (meadowsweet) have shown promise in anti-inflammatory and antibacterial properties which will be key components in rosacea [3-5]. Incorporating these herbal extracts into biopolymer films, offers a novel approach to topical delivery.

This study explores the development of biopolymer films incorporating those 3 herbal extracts into alginate-based films. The resulting films were systematically characterized for their mechanical properties, thickness, antioxidant activity by DPPH method, and infrared (ATR-FTIR) spectral features. Mechanical testing assessed film flexibility and strength, while antioxidant activity was quantified to evaluate the extracts' bioactive potential. Infrared spectroscopy provided insights into the chemical interactions within the polymer matrix.

Result showed that all extracts showed high antioxidant properties both in fresh extract and inside the formed film. The highest antioxidant activity of fresh extract was exhibited by *Epilobium parviflorum,* whereas the highest in the film was shown by *Tanacetum vulgare*. *Filipendula ulmaria* also consistently showed quite high antioxidant activity both in extract and film. The addition of the extract made the film thicker and stiffer, with higher tensile strength and Young's modulus, and lower elongation at break. In addition, the presence of glycerol did not affect the infrared spectra and interactions. The findings will support the future studies in biological testing and development of topical therapies targeting the oxidative and inflammatory components of acne rosacea.

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DEVELOPMENT OF A METHOD FOR CHROMATOGRAPHICALLY ANALYSING RISDIPLAM

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The main objective of the study was to investigate the retention of risdiplam under a variety of conditions using reversed-phase ultra-high performance liquid chromatography. This study was crucial for improving our understanding of the risdiplam retention mechanism. Five stationary phases were used in the study: octadecyl, pentafluorophenyl, diphenyl, phenyl and phenyl-hexyl. It was found that π-π interactions were dominant for risdiplam, resulting in higher retention for phenyl-based phases than for octadecyl phases. The effect of the mobile phase composition (water, salt addition, acidified water, salt concentration and pH) was evaluated, paying particular attention to the effect of pH, as this parameter appears to impact the risdiplam molecule. The pentafluorophenyl column was chosen due to its short retention time, regardless of the mobile phase used, and its relatively symmetrical peaks. The developed method enabled precise, repeatable and sensitive analysis of risdiplam in just three minutes. It was applied to analyse risdiplam in serum samples. The protein precipitation procedure was optimised in terms of the type and volume of solvent used during extraction. Finally, 10% TFA was selected as the solvent for precipitation since it enabled recovery of 90%. This is the first such complex study of the chromatographic behaviour of risdiplam and its extraction from serum samples.

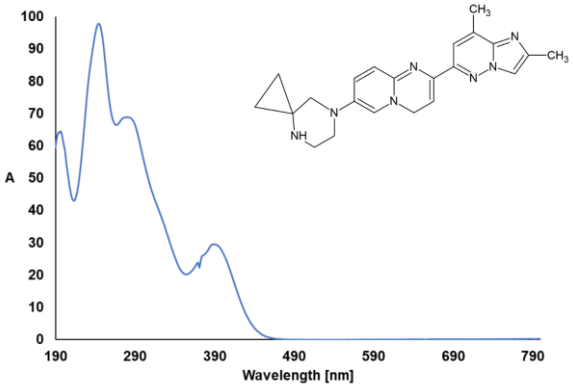

Fig. 1 Structure and UV-VIS spectrum of risdiplam. UV detection for λ from 190 to 800 nm.

The authors are grateful to National Science Centre (Cracow, Poland) for financial support under Opus project (2023/51/B/NZ7/00537).

DYNAMIC INDUCTION OF OPTICAL ACTIVITY IN CHROMOPHORIC SYSTEMS WITH INCREASING STERIC HINDRANCE

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OLED screens use light-emitting molecules. One way to improve their effectiveness might be the use of chiral compounds.

Here we present the results of our study on synthesis and optical properties of compounds containing both fluorophoric and chiral groups. We have synthesised derivatives of terephthaldehyde decorated with chromophoric (fluorophoric) groups such as triphenylamine and phenylcarbazole, which have been attached in ortho, meta or para positions (Fig. 1). The chirality of these systems was achieved by linking with chiral amines in an imination reaction, a methodology that had previously been employed in the case of other terephthaldehyde derivatives [1, 2].

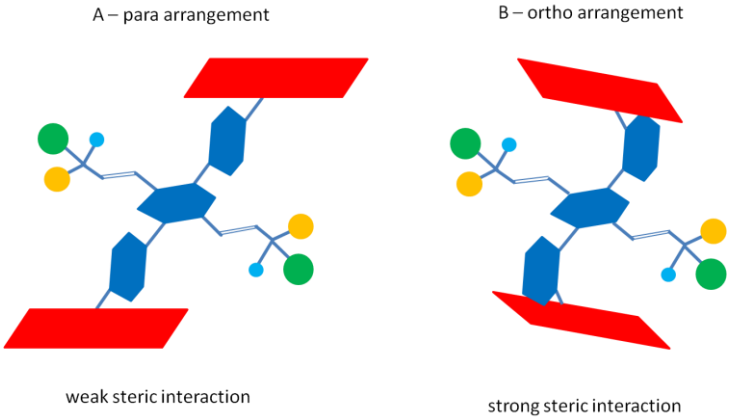

Fig. 1. Schematic representation of imines of para and ortho aldehyde derivatives. Red parallelogram represents diphenylamine or carbazol group.

The present study will discuss the effect of increasing steric hindrance, moving from para to ortho isomers, on chiroptical properties, as measured by CD and DFT structure and spectra calculations.

The project was financed by PhD Minigrant 'Chiralne układy acykliczne i makrocykliczne zdolne do emisji światła', number of project: 102/13/SNŚ/0005

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THE EFFECT OF A SUGAR ADDITIVE ON THERMAL PROPERTIES, PHYSICAL STABILITY, AND AQUEOUS SOLUBILITY OF ENZALUTAMIDE

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Prostate cancer is the second most common malignancy in men worldwide. One of the treatment is enzalutamide (ENZ), a second-generation antiandrogen. However, extremely low aqueous solubility limits oral bioavailability, requiring high doses that may reduce patient compliance and increase side effects [1].

This study proposes a co-amorphous binary system with octaacetyl maltose (acMAL) to enhance both the aqueous solubility and physical stability of ENZ [2]. Initial characterization using Broadband Dielectric Spectroscopy and Differential Scanning Calorimetry confirmed the high instability of amorphous ENZ. Co-amorphous mixtures with acMAL exhibited eutectic behavior, predicted by the Schroeder–van Laar model and confirmed experimentally during DSC measurements (Figure 1a). The eutectic and 1:1 wt% compositions were selected for further testing. Cold-recrystallization studies indicated improved physical stability of the eutectic mixture (Figure 1b). Additionally, supersaturation kinetics, assessed via solvent-shift method, demonstrated that eutectic mixture achieved more sustained supersaturation with improved solubility (Figure 1c).

These findings underscore the potential of small-molecule-based co-amorphous eutectic systems as a viable alternative to polymer-based amorphous solid dispersions, offering a promising strategy for improving the bioavailability of poorly water-soluble drugs such as ENZ.

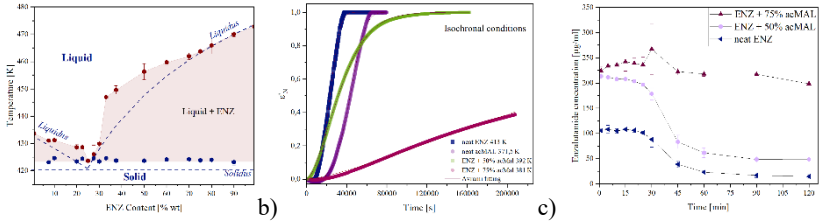

Fig. 1. Panel a shows both the experimental data obtained from DSC and the temperatures predicted with the Schröder-van Laar-Le Chatelier equation. Panel b represents normalized dielectric constant ε'_N as a function of time during a cold crystallization process at the isochronal condition. While panel c presents in vitro precipitation kinetics profiles of ENZ and its binary mixtures with acMAL at 37°C in distilled water.

This research was funded by the Young Researchers Program at the Medical University of Gdańsk (project no. 01-65025, task no. 0009305) and the National Science Centre, Poland (2023/51/B/ST5/02317, OPUS 26), within the University of Silesia's strategic program (POB 1).

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INVESTIGATING SYMMETRIC POLYSULFONATE POLYAROMATIC UREA COMPOUNDS AS A POTENTIAL INHIBITORS OF GUANYLATE KINASE FROM *MYCOBACTERIUM TUBERCULOSIS*

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Tuberculosis (TB), caused by *Mycobacterium tuberculosis*, is a chronic infectious disease that primarily affects the lungs but can also involve other organs. Despite global efforts, TB remains a major health threat, especially in developing countries, with approximately 1.5 million deaths reported in 2020 (WHO). Treatment is complicated by drug-resistant strains, highlighting the need for new therapeutic targets and more effective drugs [1].

One promising strategy is to target nucleotide metabolism, essential for bacterial DNA replication and RNA transcription. Enzymes in these pathways are vital for bacterial growth, making them attractive targets for antimicrobial therapies [2,3]. Among these enzymes, guanylate kinase (EC 2.7.4.8; GK) plays a key role by catalyzing the reversible transfer of a phosphate group from ATP to GMP, producing ADP and GDP [4,5].

In our study, we investigated seven symmetric polysulfonate polyaromatic urea compounds primarily known for their anticoagulant and anti-inflammatory properties, and occasionally used in the treatment of certain parasitic diseases [6]. We performed fluorescence spectroscopy studies to determine the binding constants for the compounds tested. The results indicate that NF279 binds the most strongly to the GK_{MT}. All tested compounds demonstrated concentration-dependent inhibition of *Mycobacterium tuberculosis* guanylate kinase, affecting both directions of the enzymatic reaction, though with varying levels of potency. The most potent inhibition was observed for NF449 in the ATP/GMP conversion (IC_{50} = 2.661 ± 0.232 μM) and NF279 in the ADP/GDP direction (IC_{50} = 2.786 ± 0.264 μM).

We further analyzed the mechanism of inhibition using Dixon plots, which revealed a non-competitive inhibition mode for both suramin and NF449. To support these findings and gain structural insight into their binding interactions, we also performed molecular docking studies, which suggested potential binding sites consistent with the observed non-competitive inhibition.

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INFLUENCE OF STRUCTURE ON PROTON CONDUCTIVITY OF ORGANIC SKELETONS WITH HYDROGEN BONDING

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Hydrogen-bonded organic frameworks (HOFs) are rapidly developing materials that constitute an ecological alternative to the MOFs (Metal Organic Frameworks). HOFs, due to their non-toxicity, low price, ease of functionalization and recovery, have found applications in many fields. For example, these materials often exhibit promising proton conductivity, therefore they can be an alternative to the expensive Nafion in PEMs (Proton Exchange Membranes) [1, 2]. The most popular tectons for HOFs are based on carboxylic or sulfonic acids, while the literature lacks described structures of organic skeletons based on diphosphonic acids [3]. In this project, three diphosphonic acids were synthesized, which, thanks to the additional hydroxyl group, created attractive hydrogen bonds, enabling efficient proton transport. Proton conductivities were measured at variable temperatures: 45-95 °C and at variable relative humidity: 45-90% (Fig. 1a).

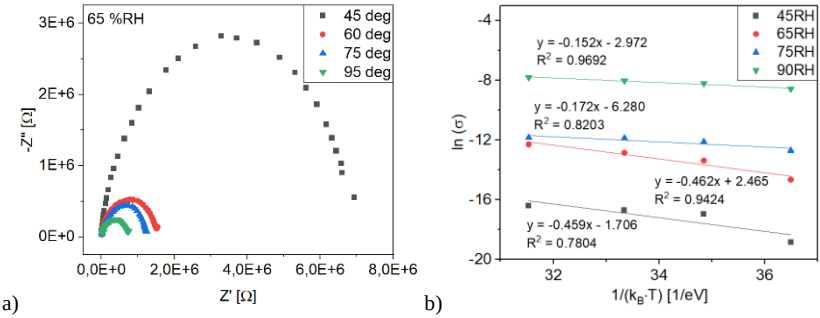

Fig. 1. a) Nyquist plot at 65 % RH and 45, 60, 75 and 95 °C, b) Activation energies for variable relative humidity.

Based on the results, the proton conductivity value and the activation energy were calculated. The most important factor influencing the quality of proton conduction is the arrangement of hydrogen bonds in the material structure. The efficiency of conduction is improved by increasing humidity. Additional water molecules help create more effective paths for proton conduction, as evidenced by a decrease in activation energy at higher humidity. For example, for 2,5-pyridinediphosphonic acid, proton conductivity values at 95 °C were $7.62 \cdot 10^{-8}$ S/cm at 45% RH and reached $4.10 \cdot 10^{-4}$ S/cm at 90% RH. The lowest activation energy determined for 90 % humidity was 0.15 eV (Fig. 1b).

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AN ALTERNATIVE APPROACH TO PLANT PROTECTION USING NOVEL IONIC DERIVATIVES OF SALICYLIC ACID

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The "Farm to Fork" Strategy aims to reduce the use of plant protection products (PPPs) by 50% by the year 2030. One of the alternatives to PPPs is the use of active substances that induce plants' natural defense mechanisms, including the phenomenon of Systemic Acquired Resistance (SAR).

Salicylic acid is a compound with proven activity related to the induction of SAR. However, due to its neutral molecular form, salicylic acid is only moderately soluble and shows phytotoxicity. As part of the research, 20 new ionic liquids—organic salts with melting points below 100°C—were synthesized as ionic derivatives of salicylic acid. Thanks to their ionic molecular form, these designable salicylates demonstrate improved physicochemical properties, including increased solubility compared to the salicylic acid molecule, and enhanced biological activity.

The aim of the multidisciplinary research was to synthesize new ionic derivatives of salicylic acid and assess effects in preventing diseases in field-grown potato and winter wheat crops. Additionally, the impact of the substance on yield quantity and quality parameters was examined. An additional goal of the study was to develop a method for determining the residue levels of the substance in the plant, its degradation rate, as well as to quantify its concentration in the edible parts of the plants at the time of harvest. The results indicate that the use of designable salicylates effectively induced SAR, leading to a significant reduction in disease severity compared to untreated controls. Moreover, in both tested crops, a significant increase in yield was observed in comparison to untreated controls.



Fig. 1 Left: Experimental fields on winter wheat. Center: SAR resistance tests. Right: Scaling up the synthesis process.

The research was carried out as part of the project titled "Growth and development stimulants with resistance-inducing effects as an innovative product for use in the cultivation of agricultural food crops", funded by the National Centre for Research and Development under the LIDER 13 program (LIDER13/0211/2022).

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DEVELOPMENT OF AN ELECTROCHEMICAL BIOSENSOR FOR SPECIFIC DETECTION OF *BACILLUS ANTHRACIS* SPORES USING ANTIBODY–ANTIGEN IMMUNOREACTION

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This study aimed to design an electrochemical immunosensor capable of rapid and selective detection of Bacillus anthracis spores — a CDC class A biological threat agent with high bioterrorism potential. Unlike traditional methods such as PCR or ELISA, the developed sensor enables in-field operation, reduces analysis time, and provides high selectivity through the use of a specific antibody–antigen recognition mechanism.

To prepare the sensing platform, a gold electrode was functionalized through a multi-step procedure: a self-assembled monolayer of TBBT was formed, gold nanoparticles were deposited, and monoclonal antibodies against B. anthracis were immobilized. These antibodies were selected based on ELISA screening and principal component analysis to ensure specificity. The biointerface was stabilized with albumin to prevent nonspecific adsorption. Electrochemical measurements were performed using cyclic voltammetry, which enabled simultaneous analysis of potential and current changes following spore binding.

High analytical sensitivity was achieved, with a detection limit of 10^3 CFU/ml and a dynamic response across the 10^3–10^8 CFU/ml range. Crucially, the ratio of potential shift to current change (E/I) emerged as a reliable indicator, allowing accurate discrimination of B. anthracis even in the presence of closely related Bacillus species or other microbial interferences.

To validate the sensor's performance, blind-coded samples and complex environmental matrices were analyzed. Results consistently confirmed high selectivity and robustness of detection. Additionally, a compact, portable device compatible with the biosensor was constructed, enabling real-time, in situ analysis without external power or computer systems.

These findings support the utility of the proposed biosensor in field diagnostics, biosecurity surveillance, and rapid-response scenarios, with relevance to both civilian and military applications.

This work was funded by the Military Medical Service Department of Ministry of National Defence (No. 132/2019/DA).

BIOLOGICAL ACTIVITY OF IRIDIUM(III) COMPLEXES WITH CYCLOMETALATING PYRAZOLE DERIVATIVE

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One of the main approaches to cancer treatment, currently the second leading cause of death worldwide, is chemotherapy [1]. However, cisplatin, one of the most commonly used chemotherapeutic agents, is associated with various side effects, including neurotoxicity, nephrotoxicity, and the development of drug resistance during prolonged treatment [2].

For years, researchers have been searching for coordination compounds based on metal ions from the platinum group that could offer comparable or improved therapeutic effects, with the potential to replace existing platinum-based drugs. Among these, cyclometalated iridium(III) complexes have emerged as a promising class of compounds due to their notable antiproliferative activity [3].

In this study, we present a series of novel heteroleptic Ir(III) complexes bearing a cyclometalating 3,5-dimethyl-1-phenylpyrazole ligand. The compounds were thoroughly characterized using physicochemical methods, and their antiproliferative activity was evaluated against selected cancer cell lines as well as a healthy cell line. The newly synthesized complexes demonstrated high cytotoxicity at the micromolar concentration range [4].

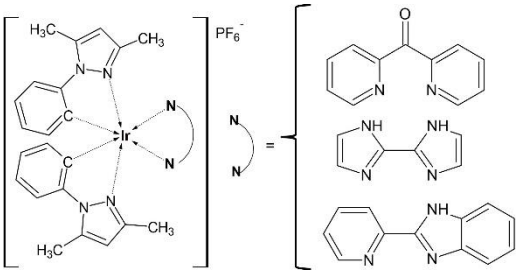

Fig. 1. Chemical formulas of iridium(III) complexes with cyclometalating pyrazole derivative.

The participation is funded by JKU SUPD.RN.25.021 grant

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DISPERSIVE SOLID-PHASE EXTRACTION OF ANTISENSE OLIGONUCLEOTIDES USING AMINO ACID-BASED ADSORBENTS

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Antisense oligonucleotides (ASOs) are short, synthetic fragments of nucleic acids that can selectively bind to the target mRNA, influencing, for example, gene expression [1]. Recently implemented in the treatment of some diseases. An example of such therapeutic interventions is the use of nusinersen (Spinraza) in the treatment of spinal muscular atrophy (SMA) or eteplirsen (Exondys 51) in the treatment of Duchenne muscular dystrophy (DMD) [1-2]. The introduction of this type of treatment is associated with the need for process monitoring [3].

In the study, five silica-based adsorbents modified with propylamine and various amino acids (leucine, tyrosine, serine, alanine, methionine) were used for dSPE of ASOs. Oligonucleotides were analyzed using ion-pair ultrahigh-performance liquid chromatography.

The influence of the pH level and the concentration of five solvents on the adsorption of ASO was investigated. Adsorption exceeding 99% was achieved for each of the materials tested, consistently. Adsorption kinetics were examined. The sorption capacity was 91 μg/mg. The influence of the pH and concentration of the ammonium acetate solvent on the desorption process was examined. The optimized dSPE procedure included: loading the sample into 10 mM ammonium acetate (pH 4), washing with a methanol/ammonium acetate mixture (1/9 v/v) and desorption with 10 mM ammonium acetate (pH 11). Determined that the extraction process mainly depends on electrostatic interactions (weak ion-exchange).

Three oligonucleotide analogues of nusinersen were tested, differing in modification: 2'-O-methyl (Me), phosphorothioate (PS) and a combination of both (PS-Me). The lowest recoveries (60%) were observed for the unmodified oligonucleotide, while Me, PS and PS-Me showed a higher recoveries, probably due to increased hydrophobicity of the oligonucleotide due to the modification. Oligonucleotide length also had an effect on recovery, with the 16-mer PS giving better results than the longer analogues. The developed extraction method proved to be effective and selective in isolating these oligonucleotides from enriched serum (recoveries above 90%). The conducted studies reveal the potential of using amino acid based adsorbents for an easy and effective extraction of ASO from serum samples.

The authors are grateful to National Science Centre (Cracow, Poland) for financial support under Opus project (2023/51/B/NZ7/00537).

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IN SILICO ANALYSIS OF POTENTIAL ANTICANCER ACTIVITY OF THIAZOLE DERIVATIVES

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Human dihydrofolate reductase (hDHFR) is an enzyme that catalyzes the reduction reaction of dihydrofolate to tetrahydrofolate [1]. This transformation is crucial in the synthesis of thymidine monophosphate (TMP) from deoxyuridine monophosphate (dUMP), which is essential for DNA synthesis – Fig.1 [2].

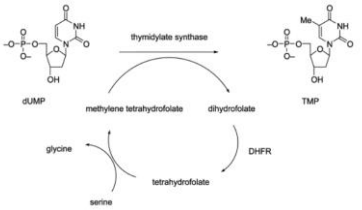

Fig 1 Scheme of metabolic transformations leading to the formation of TMP

For this reason, hDHFR inhibitors are used as anti-cancer drugs. One of the substances used for this purpose is methotrexate, but due to its unwanted effects such as damage to the lungs and liver, new substances capable of inhibiting the enzyme characterized by less toxicity are constantly being searched for [3,4].

The 14 thiazole derivatives were subjected to a molecular docking procedure. Based on the ligand-protein binding energy and experimental results, the most promising compounds were selected for further analysis. The ways in which ligands interact with the enzyme were investigated, and statistical analysis of the docking results was performed. Then for the selected compounds molecular dynamics simulations were executed and analyzed for the stability of the formed ligand-protein complexes and the time evolution of the hydrogen bonds systems. The results were compared with reference ligands such as methotrexate, trimethoprim and doxorubicin.

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AAO LAYERS WITH COMPLEX CHANNELS GEOMETRY OBTAINING BY MODIFYING THE ANODIZATION CONDITIONS

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Anodic Aluminum Oxide (AAO) is a self-ordered alumina form obtained in properly selected conditions during the anodization process. Due to the wide range of morphology control [1] and its regular, hexagonal pore arrangement, the AAO has found applications in many fields of science and technology [2]. The alumina layers with complex channels geometry can be achieved by changing the voltages during the synthesis [3] or using the selected electrolyte with a precisely defined composition [4, 5]. The purpose of this presentation is to show the effect of changes in anodizing conditions (e.g., various electrolytes including mixtures of different acids, the addition of non-aqueous solvent or variable hydrodynamic conditions, and system geometry) on AAO morphology and kinetics of oxide layers formation.

AAO layers were obtained during the two-step anodization of aluminum foil. The process was carried out at a constant temperature. Solutions of different acids and water-alcohol solutions were used as electrolytes. It was observed that the application of mixtures of different acids or aqueous-alcohol solutions as electrolytes enables the formation of anodic alumina beyond the self-optimal voltage ranges for most commonly acids used in this process (Fig.1). In case of voltage or hydrodynamic conditions changes it was possible to obtain channels with complex geometry (e.g., Y-branched).

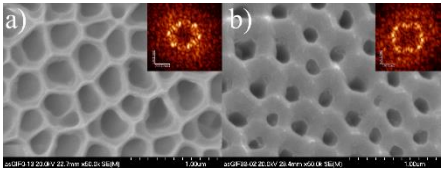

Fig. 1. The SEM photos of AAO surfaces with FFT images obtained at 140 V in: a) 0.3 mol/dm^3 phosphoric acid, b) 0.3 mol/dm^3 phosphoric acid in water – glycerol in 1:1 volume ratio

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FREEZE-DRIED EMULSION AND BIGEL SYSTEMS: NOVEL ECO-CONSCIOUS MATERIALS FOR COSMETIC APPLICATIONS

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Water is the main component of most cosmetic formulations, including emulsions. Although it serves as a base ingredient and a solvent for other substances, it does not provide a cosmetic effect on the skin. In light of the global water crisis and the decreasing availability of clean, easily accessible water, sustainable technological solutions are being sought. One such approach may involve water recovery through freeze-drying, forming porous, lightweight materials with potential topical applications [1].

Emulsions are biphasic systems – comprising aqueous and oil phases – stabilized by emulsifiers [2]. Bigels are formed by combining hydrogels and oleogels, which consist of a water-based phase containing hydrophilic polymers and an oil phase gelled with an organogelator, respectively [3–4]. Both types of systems combine the advantages of aqueous and oily phases: they enable effective delivery of hydrophilic and hydrophobic active ingredients, offer pleasant application properties, and provide adequate skin hydration and conditioning.

The study aimed to obtain and characterize eco-friendly materials in the form of freeze-dried emulsions and bigels based on polymers (whey protein isolate, sodium alginate, ethyl cellulose), mannitol, sea buckthorn oil, beeswax, and an emulsifier (Span-80). The materials were characterized using SEM, mechanical properties, porosity, density, and moisture content. Additionally, the influence of the topical application of the developed materials on the biophysical skin parameters was evaluated, including transepidermal water loss (TEWL), skin color, and surface hydration level, using Courage+Khazaka probes. The materials were designed to rehydrate with a minimal amount of water directly before application to the skin, thereby reconstructing the original emulsion or bigel.

The obtained results confirm the potential of the developed materials as functional bases for innovative cosmetic or dermatological formulations intended to improve skin condition.

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SUBSTITUENT AND SOLVENT EFFECTS ON THE PHOTOPHYSICAL PROPERTIES OF BF_2-CONTAINING FLUOROPHORES – A QUANTUM CHEMICAL STUDY

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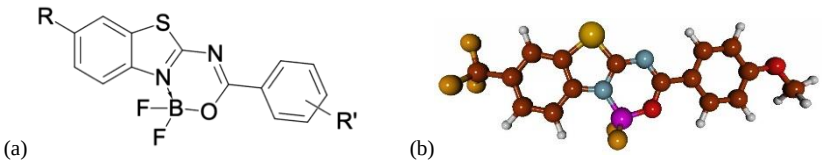
Organic fluorophores - benzothiazole-difluoroborates represent a promising class of compounds for applications in bioimaging and optoelectronics due to their tunable emission properties and favorable photophysical characteristics. In this study, a series of 25 benzothiazole-based fluorophores bearing various electron-donating and electron-withdrawing groups was investigated to evaluate the substituent effects on their photophysical behavior [1].

In the first part, TD-DFT calculations were carried out with inclusion of solvent effects of chloroform environment using the SCRF/PCM model to determine absorption and emission energies, 0–0 transitions, and oscillator strengths. The computational results were compared with available experimental data, showing agreement in emission wavelength trends [2].

The second part of the study explored the explicit solvent effects by introducing individual solvent molecules—chloroform (nonpolar, aprotic) and methanol (polar, protic)—as part of cluster structures. Intermolecular interaction energies were calculated using both supermolecular approaches and SAPT (Symmetry-Adapted Perturbation Theory) [3]. Additionally, methodological benchmarks were conducted to identify optimal functionals and basis sets.

This combined approach provides insight into how substituent and solvent effects influence photophysical properties, which may inform the rational design of tailored fluorescent systems in the future.



(a) (b)

Fig. 1. (a) Structure of the investigated compounds with the R substituent in the benzothiazole part and the R' substituent in position 3 or 4 in the phenyl ring (R = OMe, H, CF_3; R' = 4-NMe_2, 4-OMe, 4-Me, 3-Me, H, 4-Cl, 4-Br, 3-F, 4-F, 4-CF_3, 4-NO_2), (b) molden [4] visualization of a molecule substituted with CF_3 and 4-OMe groups.

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ION IMPRINTING TECHNOLOGY VS CHITOSAN - A NEW ERA IN REMOVAL OF POLLUTION AND RECOVERY OF METALS FROM WASTEWATER

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The quality of drinking water is threatened by industrialization and population growth, making it necessary to treat water respectfully [1]. Wastewater treatment methods directly used are not very convenient; therefore, more advanced techniques are in demand. One promising technique is adsorption, in which solid adsorbents remove contaminants, such as dyes, oil spills, pesticides, pharmaceutical products, and metal ions [2]. The removal of metal ions is imperative due to the harmful effects of heavy metals on aquatic flora and the growing demand for critical metals, as outlined in EU directives [3]. Ion-imprinting technology, especially combined with biopolymers such as chitosan, may show great promise for removing metal ions from water and wastewater owing to its high selectivity and adsorption capacity. This paper reviews the principles and preparation methods of ion-imprinted chitosan (IICs) adsorbents, with a specific focus on the preparation materials for the removal of heavy metals and recovery of critical metals mentioned in the EU report. The review addresses the challenges faced by chitosan ion-imprinted technology and explores its prospects for application in many areas of science.

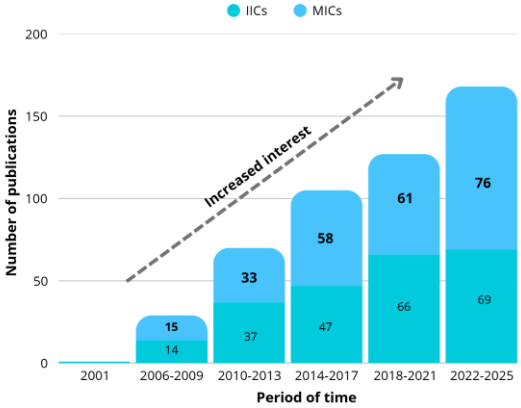

Fig. 1. Number of publications related to the use of chitosan in ion-imprinted technology as composites in 2001 – 2025 using the SCOPUS database (last access: 25.05.2025). IICs – (chitosan AND ion-imprinted OR "IIP" OR "IIPs"), MICs – (chitosan AND molecular-imprinted OR "MIP" OR "MIPs").

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SECTION OF CHEMICAL SCIENCES
POSTER PRESENTATIONS

FLUORESCENT DYES BASED ON PERYLENE STRUCTURE

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Among the natural fibers used in the textile industry, cellulosic fibers are the most popular. For dyeing cotton, mainly reactive dyes are used which bind to the dyed fiber by forming a covalent bond. The present work is devoted to the synthesis of new reactive dyes based on the perylene backbone. I decided to use this structure because perylene has high thermal, chemical and photochemical stability. Due to the strongly conjugated extended aromatic system, the compound in question tends to form so-called π-π interactions. The obtained dyes were characterized by the phenomenon of fluorescence, while the dyed cotton obtained a high degree on fastness tests. In addition, it was the optical properties of the dyed fabrics that were examined.

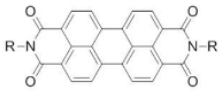

Fig. 1. Structure of the tested dyes

Acknowledgement: This work has been completed while the first author was the Doctoral Candidate in the Interdisciplinary Doctoral School at the Lodz University of Technology, Poland

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TARGETING THE NMD PATHWAY: DESIGN AND SYNTHESIS OF 1,3-DISUBSTITUTED UREAS AS NOVEL INHIBITORS OF THE UPF1

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This study aims to investigate the molecular interactions within the UPF protein system involved in the **Nonsense-mediated mRNA Decay** (NMD), with a specific focus on the principal regulator, **UPF1 protein** [1]. Our approach includes finding and obtaining potentially active lead compounds and their derivatives that can interact with the UPF1 ATP-binding site and function as UPF1 inhibitors.

Based on the in silico screening of the considered database libraries and MDS, the potential active small-molecule inhibitors containing a 3-[4-(R1-sulfamoyl)phenyl]urea scaffold have been identified and selected. Several methods and optimisation procedures have been performed for the organic synthesis of the highlighted chemical structures. One of the proposed synthesis procedures includes three steps, which allows us to obtain novel and previously unreported structures – **1,3-disubstituted ureas**. Synthesised products are expected to possess inhibition, biological and especially anticancer activity.

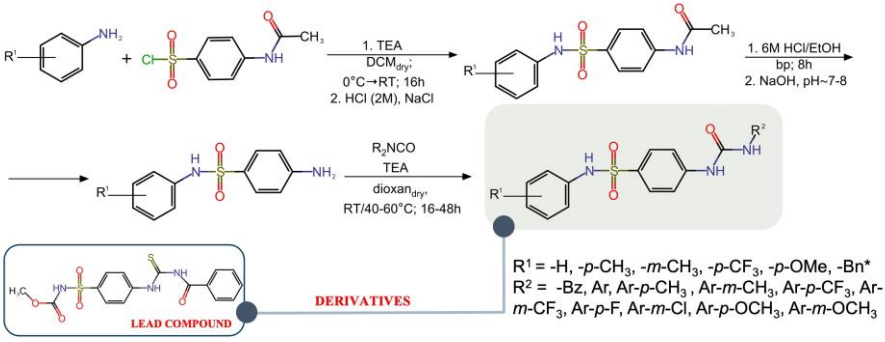

Fig. 1. Organic synthesis pathway for the current research.

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Bartosz Maćkowiak Eng., Paweł Mania MSc Eng., Julia Neumann MSc Eng.: for obtaining several chemical compounds for the current research within the Masters theses at the Department of Organic Chemistry, Gdansk University of Technology.

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EFFICIENT REMOVAL OF POTENTIALLY TOXIC ELEMENTS FROM DIGESTED SEWAGE SLUDGES USING PROTIC IONIC LIQUIDS

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The agricultural use of sewage sludges (SSLs) aligns with the principles of sustainable development and the circular economy, providing an effective waste management solution [1]. However, SSLs, especially after advanced stabilization processes such as anaerobic digestion, often contain higher levels of potentially toxic elements (PTEs) than before stabilization, which may limit their environmental application [2]. Protic ionic liquids (PILs), formed by proton transfer between a Brønsted acid and base [3], are promising for removing PTEs from complex matrices like SSLs [4]. The aim of this study was to apply PILs with diverse properties (1-methylimidazolium chloride ($[H_1Cim]Cl$), triethylammonium hydrogen sulfate ($[TEA][HSO_4]$), and 1-methylimidazolium hydrogen sulfate ($[H_1Cim][HSO_4]$)) for the removal of PTEs from digested SSLs. The focus was on the extraction of Zn, Cu, Cd, Pb, Ni, and Cr, whose contents in SSLs used in agriculture are subject to legal regulations. In addition to determining the removal efficiency, the study investigated the mechanism of action of individual PILs. Under optimal conditions, $[H_1Cim]Cl$ exhibited the highest metal extraction efficiency, removing between 11% and 82% of PTEs depending on the metal type. The results indicated that extraction parameters (temperature, SSL:PIL ratio, number of ethanol washing cycles), as well as the type of SSL and the chemical forms of PTEs in SSL, significantly influenced process efficiency. The efficiency of $[TEA][HSO_4]$ was lower than that of the most effective $[H_1Cim]Cl$ and ranged from 5% to 70% for the same PTEs. $[H_1Cim][HSO_4]$ was found to be impractical due to difficulties in separation from the treated SSL. The obtained results confirm the effectiveness of PTE removal from SSLs using selected PILs, which may represent an interesting approach to SSL management in line with circular economy principles.

This research was funded in whole by National Science Centre, Poland under Grant number 2021/43/D/NZ9/02718.

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PHOTODYNAMIC THERAPY: NOVEL PORPHYRAZINE DERIVATIVES WITH POTENTIAL ANTI-TUMOR ACTIVITY - SYNTHESIS AND OPTICAL CHARACTERIZATION

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Porphyrazines are tetrapyrrolic macrocycles widely used as potential photosensitizers in photodynamic therapy (PDT) – an anti-cancer treatment of various types of cancers, including malignant brain tumors [1]. Due to high reactive oxygen species (ROS) generation under light irradiation, tunable photophysical properties and ability to perform chemical modification, utilization of porphyrazines as photosensitizers in PDT becomes a great alternative to conventional cancer treatments (radiotherapy, neurosurgery, chemiotherapy), particularly in Glioblastoma multiforme eradication [2].

The current study aimed to synthesize two novel porphyrazine derivatives and investigate their physicochemical and optical properties for further medical purposes. Towards this objective we decided to prepare two types of derivatives: a symmetrical A4-type (Pz1) and an unsymmetrical A3B-type (Pz2) (Fig. 1) to compare the impact of the number of methoxyphenyl substituents on the macrocycle activity. The zinc(II) as a coordinating atom should improve ROS generation under light irradiation as it was shown previously [3].

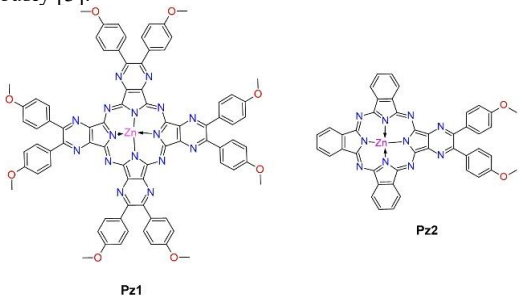

Figure 1. The chemical structures of obtained derivatives

The obtained compounds were characterized using 1D and 2D NMR techniques (COSY, HSQC, and HMBC). Their absorption maxima in the UV-Vis range were determined, along with their emission and excitation spectra. Moreover, both porphyrazines were evaluated for their singlet oxygen generation yield—a crucial parameter for characterizing photosensitizers. In addition, the compounds were subjected to the Microtox® assay to assess their potential acute toxicity toward Aliivibrio fischeri.

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MOLECULAR TAXIS FOR DRUGS – INCLUSION COMPLEXES OF β-CYCLODEXTRIN WITH SELECTED ANTIASTHMATIC AGENTS

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Contemporary approaches in the design of pharmaceutical dosage forms focus on strategies that enable controlled and prolonged release of active pharmaceutical ingredients [1, 2]. One promising direction involves inclusion complexes with cyclodextrins, which, by encapsulating drug molecules within the hydrophobic cavity of the host, can enhance solubility [3, 4], stability [5, 6], and reduce drug-related side effects [7, 8].

In this study, a quantum chemical analysis was conducted on host–guest complexes formed between β-cyclodextrin and two anti-asthmatic drugs: salbutamol (SAL) and tulobuterol (TUL). Conformational analyses of both drugs were carried out, followed by geometry optimization of the complexes in various orientations (Figure 1) and environments (vacuum, water), using the B3LYP and M06-2X functionals, along with dispersion corrections D3 and D3BJ. For both SAL and TUL, the preferred orientation was the "head" configuration, where the aromatic ring of the drug is directed into the β-CD cavity. SAL forms more stable complexes than TUL, exhibiting stronger interaction energies and a greater number of hydrogen bonds. The results highlight the importance of careful selection of computational methods in the study of supramolecular interactions, particularly regarding the role of dispersion in stabilizing the complexes.

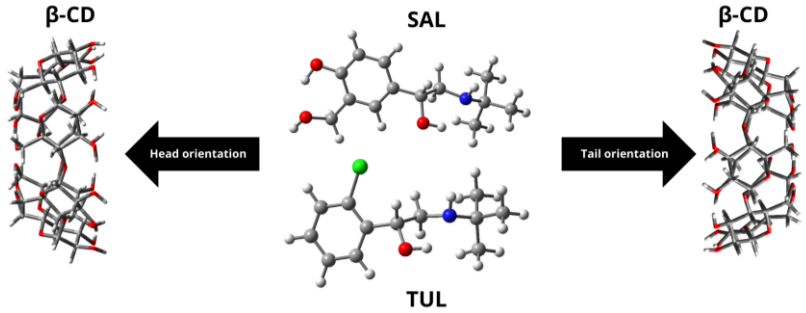

Fig. 1. Orientations of drug molecules inside β-cyclodextrin

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CHEMO-ENZYMATIC SYNTHESIS OF 10-KETOSTEARIC ACID FROM OLEIC ACID

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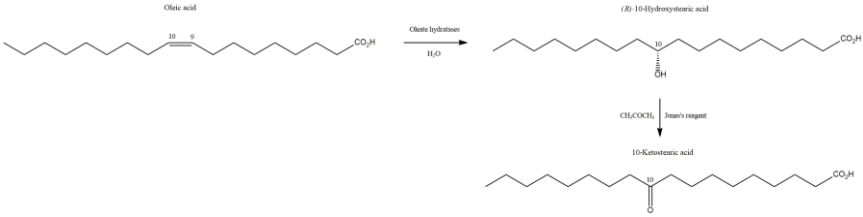
Long-chain hydroxy acids and their derivatives represent an important group of chemical compounds with broad applications in the cosmetic, pharmaceutical, and biomedical industries, including use as components of skincare formulations, carriers of active substances, and intermediates in the synthesis of biological materials **[1,2]**. Particularly attractive are hydroxy acids formed via selective hydration of natural fatty acids, such as oleic acid, which enables the production of enantiomerically pure compounds with high biological value.

The aim of this study was to develop a two-step synthesis pathway for 10-ketostearic acid, involving enzymatic hydration of oleic acid followed by chemical oxidation of the obtained 10-hydroxystearic acid (10-HSA) **(Scheme 1)**.



Scheme 1. Two-step synthesis pathway for 10-ketostearic acid

In the first stage, the biotransformation of oleic acid to 10-hydroxystearic acid (10-HSA) was carried out using recombinant oleate hydratase from *Lactobacillus rhamnosus* ATCC 53103, produced in *Escherichia coli* **[3]**. Subsequently, 10-HSA was subjected to chemical oxidation using Jones reagent in acetone, resulting in the formation of 10-ketostearic acid.

The obtained compound, due to the presence of a ketone group, can be used for the synthesis of phospholipids with modified biological and physicochemical properties. The presented method combines the high enantioselectivity of biotransformation with the high efficiency of chemical synthesis, offering a sustainable and efficient alternative to classical methods for the synthesis of oxy-fatty acids.

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LACTOFERRIN AS A CARRIER FOR CISPLATIN: SYNTHESIS, PHYSICOCHEMICAL CHARACTERIZATION, AND CYTOTOXICITY ASSESSMENT IN TARGETED CANCER THERAPY

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Platinum-based chemotherapeutic agents are highly effective in treating a broad spectrum of cancers; however, they are currently limited to being administered via intravenous injections. This method of delivery comes with several drawbacks, including a rapid spike in drug levels in the bloodstream, exceeding the maximum safe concentration, followed by a swift decline below the effective therapeutic threshold. The challenge lies in developing an approach that enables the effective absorption of these drugs in the gastrointestinal tract when taken orally. The method should aim to accurately target the drugs to the intestinal epithelial cells while minimizing side effects, such as the chemical reactivity of platinum ions and their compounds, as well as gastrointestinal issues. In our study we have developed solution that involves using a carrier that can both be recognized by intestinal epithelial cells and potentially protect the digestive system from harmful effects. Lactoferrin (LTF) was used as the carrier for platinum compounds.

Our innovative approach involved the use of lactoferrin (LTF), a naturally occurring protein, as a carrier for platinum-based compounds. Lactoferrin is known for its ability to bind to intestinal epithelial cells [1] and possesses protective properties against gastrointestinal irritation [2]. The primary aim of our study was the synthesis and characterization of a lactoferrin–cisplatin complex that could facilitate safer and more effective drug delivery.

The complexes were synthesized in two different buffers. Various analytical techniques, such as FTIR, Raman and UV-Vis spectroscopy, were used to characterize the resulting compounds. ICP-OES analysis was performed to determine the amount of bound platinum. Additionally, MALDI-TOF MS and SDS-PAGE studies were conducted, along with DLS particle size measurements. To analyze the structure and stability of the lactoferrin-cisplatin complex, MD simulation was carried out. The cytotoxicity of the obtained complexes was also evaluated using the MTT assay on two cell lines, Caco-2 (intestinal epithelial) and L929 (fibroblast). The results indicate promising directions for improving the bioavailability and therapeutic performance of platinum-based drugs through oral administration, potentially overcoming the significant limitations associated with their traditional intravenous delivery.

Acknowledgments
This study was funded by the Grants4NCUStudents 8 competition within the Excellence Initiative – Research University program, project title "Study on the Action of Cisplatin-Lactoferrin Complexes on the Apoptotic Pathway". P.P. and O.P. are members of Toruń Center of Excellence "Towards Personalized Medicine" operating under Excellence Initiative-Research University.

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POLYLACTIDE / HALLOYSITE NANOCLAY / POLYTETRAFLUOROETHYLENE NANOCOMPOSITES FOR FOAMING

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Polymer foams represent a promising field of materials, providing a multitude of advantages, including light-weightiness, high strength, high surface area and cost effectiveness [1]. Nevertheless, biopolymers like Polylactide (PLA) have limitations such as low melt viscosity, brittleness, high cost, low thermal resistance, and slow crystallization making it inefficient for foam production [2]. To mitigate these disadvantages, several techniques can be employed; among which blending polymer matrix with nucleating agents has been shown to improve their melt strength, cell density, cell size, and melt strain. Consequently, improving its rheological and foaming properties [3].

In this study, halloysite nanoclay (HNC) and polytetrafluoroethylene powder (PTFE) were introduced into PLA via a melt mixing technique. The synergetic effects of varying concentrations of HNC and PTFE on PLA matrix were investigated on their mechanical, rheological properties and foaming ability. Results showed improved tensile properties, decreased crystallization time with filler concentration, and a nucleating effect on PLA crystallization, potentially altering foaming behavior. Extensional flow tests demonstrated strain hardening in PLA composites were influenced by fillers, particularly PTFE due to deformation and fibrillar entanglement during melt processing. The addition of a dual-filler system improved melt strength and viscosity, resulting in foams with reduced cell size and increased cell density.

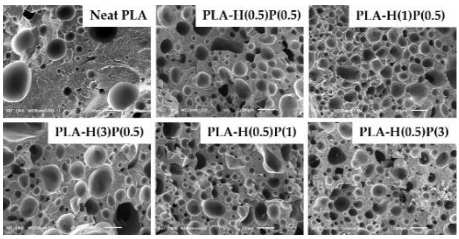

Fig. 3. SEM image of different concentrations of HNC and PTFE in PLA nanocomposite foams

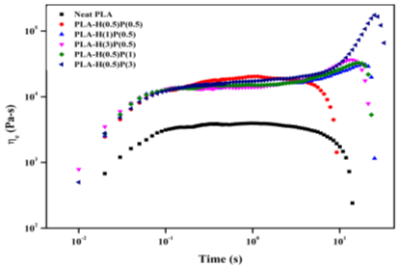

Fig. 2. Extensional viscosity vs. time graph for PLA nanocomposites

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ANALYSIS OF NEW COORDINATION COMBINATIONS OF S-BLOCK METALS WITH SELECTED NONSTEROIDAL ANTI-INFLAMMATORY DRUGS

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Non-steroidal anti-inflammatory drugs (NSAIDs) are among most frequently taken pharmaceuticals. They are used to relieve pain, fever, and osteoarthritis [1]. Their anti-inflammatory effect relies on inhibition of cyclooxygenase (COX). It is enzyme which mediate inflammation in the body [2]. Unfortunately, long-term NSAID therapies can lead to serious side effects such as abdominal pain, indigestion, nausea and serious gastrointestinal problems such as bleeding and perforation. Bioactivity and bioavailability of organic drugs can be improved by complexing them with appropriately selected metal cations [3].

Not enough attention has been paid to complexes based on alkaline earth metal ions [4]. These metal ions play crucial roles in many biological pathways, such as cellular diversity, division, apoptosis, homeostasis, regulation of electrolyte balance, pH, and nerve impulses [5]. In addition most s-block cations are nontoxic and soluble in aqueous environments [6].

In this communication, I present the results of studies of coordination compounds of s-block metals with selected nonsteroidal anti-inflammatory drugs. I present methods of analysis of the synthesized compounds and the obtained results of thermal analysis, IR spectroscopy and antioxidant properties by spectrophotometry method.

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INFLUENCE OF POLYMER MATRICES ON PHOTOPHYSICAL PROPERTIES OF AZODYES THIN FILMS

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Azobenzene is a well-known organic photoswitchable chemical compound. The most interesting property of azobenzene is the possibility of facile and reversible *trans-cis* photoisomerization of the azo bond under the influence of UV-visible light, which causes rapid changes in its geometry and dipole moment. Such unique photoresponsiveness enables precise control of the optical properties, making them ideal for photonic switches, optical storage, and adaptive surfaces [1].

In this work, we have studied various host-guest systems fabricated as thin films using the spin-coating method. Disperse Red 1, Disperse Red 13, and Disperse Orange 3 were dispersed in three different polymer matrices: chitosan, poly(methyl methacrylate) (PMMA), or poly(4-vinylpyridine) (P4VP). FTIR spectroscopy confirmed hydrogen-bonding interactions between polymer functional groups (–OH in chitosan, C=O in PMMA, and pyridyl N in P4VP) and azo dye moieties (–N=N–, $–NO_2$). Such interactions ensured uniform dispersion and prevented aggregation while maintaining the photoisomerization efficiency of the dyes [2].

Under the illumination of polarized light, the surface relief gratings are formed in the azo dye layer. Atomic force microscopy analysis showed smooth surfaces of azo dye layers before light exposure, which turned into surface patterns after light irradiation. We have also verified that our azo dye films became "directionally sensitive" to light (optical birefringence), which is a result of the dye molecules being aligned in specific directions when exposed to polarized light. These results demonstrate that hydrogen bonds between dyes and polymers allow us to obtain films whose response to light can be precisely controlled. Such materials are promising for light-driven technologies like optical circuits, biosensors, and smart coatings [3, 4].

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NEW COMPLEXES OF NICKEL(II) AS POTENTIAL PRECURSORS FOR VAPOUR DEPOSITION METHODS

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Vapour deposition methods, such as Chemical Vapour Deposition (CVD) and Focused Electron Beam Induced Deposition (FEBID), can be applied to produce metallic structures. Therefore, they play an important role in e.g. nanoelectronics, catalysis, nanophotonics, and nanosensors. These techniques require metal-containing precursors, which exhibit sufficient volatility and thermal stability. Moreover, for the FEBID method, electron sensitivity is also crucial [1-2].

New nickel(II) complexes with perfluorinated carboxylate and primary aliphatic amines RNH_2 were synthesised using conventional synthesis in solvent and compositionally characterised. A mechanochemical synthesis method (so-called green chemistry synthesis) was also developed. Their physicochemical properties were studied with thermal analysis and sublimation-resublimation experiments. The selected compound was used as a precursor in preliminary CVD experiments. Furthermore, the sensitivity to high- and low-energy electrons was studied for the complexes using scanning electron microscopy with energy dispersive X-ray spectrometry (SEM-EDX) and electron ionization mass spectrometry (EI MS). The results indicate that the new nickel(II) complexes can be promising as precursors for both mentioned vapour deposition techniques.

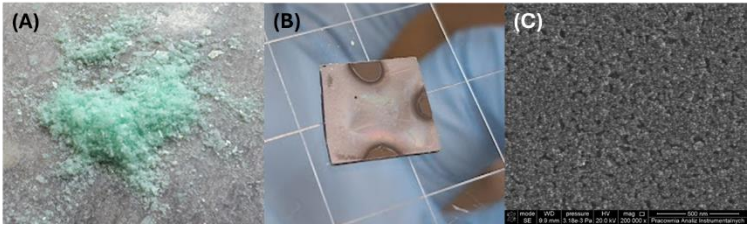

Fig. 1. Nickel(II) carboxylate complex with amine: (A) formed green powder, (B) adsorbed thin layer on Si substrate, (C) CVD deposited nickel-containing film on Si substrate (SEM image).

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ENHANCING ANTIOXIDANT ACTIVITY OF ALGERIAN ENDEMIC PLANT EXTRACTS VIA WHEY PROTEIN ENCAPSULATION

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Whey protein, derived from dairy production, has garnered significant attention due to its nutritional and functional properties. In addition, it's rich in composition, i.e., in bioactive compounds. β-lactoglobulin and α-lactalbumin are effective encapsulating agents for vegetal bioactive compounds, enhancing the stability, bioavailability, and controlled release of phenolic and antioxidant compounds [1-3].

This study aims to extract bioactive compounds from Algerian endemic plants using the Soxhlet method, using various solvents, among which methanol gives the highest yield. Methanolic fraction was found to be rich in phenolic compounds, with total phenolic content equal 52,65 mg/g_{plant}. The DPPH-evaluated antioxidant activity of the extract was 63µmol equivalent Trolox/g. To improve the stability and bioactivity of the extract, denatured whey protein isolate was used as an encapsulation matrix. The 0.5 wt.% extract content was tested in 5 wt.% of denatured whey protein solution. Remarkably, the antioxidant activity increases to 117.29 63 µmol equivalent Trolox/g_{plant} with an efficiency of encapsulation of 60%.

This novel method not only maintains but also enhances the plant extracts' functional qualities, indicating potential uses in natural antioxidant delivery systems, functional foods, and nutraceuticals. This study also highlights the Algerian native flora's unrealized potential as a significant natural antioxidant source.

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CORE-SHELL NANOSTRUCTURES AS INNOVATIVE NANOCARRIERS IN DRUG DELIVERY SYSTEMS

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Nanotechnology is a dynamically developing field of science that deals with the design, synthesis, and application of nanometric structures. Due to the unique physicochemical properties of nanomaterials, which are often different from their macroscopic counterparts, nanotechnology is used in many areas, from medicine and pharmacy, through electronics, to environmental protection and the food industry. In the field of biomedical sciences, nanomaterials, thanks to the possibility of precise control of their size, shape, surface and chemical functionalization, are used as drug carriers, diagnostic agents, components of biomaterials and in targeted therapy, which opens up new perspectives for more effective treatment of diseases, increasing the bioavailability of drugs and minimizing the side effects of therapy [1].

Among the various nanomaterials, core-shell nanostructures are of particular interest, especially those built with a metallic core such as gold nanoparticles (Au NPs) and a silica shell (SiO_2). The gold core provides good biocompatibility, functionalization possibilities, and potential photothermal and antioxidant properties, while the silica shell stabilizes the structure and enables encapsulation of both hydrophilic and hydrophobic substances. Due to the large specific surface area and the possibility of adjusting the shell thickness, Au@SiO_2 shows potential in controlled drug release and its targeted delivery to diseased tissues. Additionally, due to the synergy of the properties of nanostructures and the drug, this nanosystems are a promising and alternative platform in the design of innovative and intelligent drug carriers [2,3].

In this work, Au@SiO_2 nanostructures were designed, synthesized, and characterized using a number of analytical techniques such as spectroscopic (UV-Vis), microscopic (TEM, SEM), and light scattering (DLS, ELS) methods. The encapsulation process of the model drug was also carried out, its presence in the system was confirmed, the release profile was examined, and the biological activity of the obtained nanosystem was assessed.

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DETERMINATION OF SELECTED BIOGENIC AMINES AND THEIR PRECURSORS IN POULTRY MEAT PROTECTED BY CHITOSAN FILM

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Meat and its products are perishable food commodities that require proper processing to extend their shelf life and refrigeration. Meat is an essential component of the modern diet around the world, and a potential increase in the production and consumption of meat and meat products inevitably leads to an increase in the use of packaging materials. Food packaging comprises an essential portion of the food industry. However, its innovation has been driven mainly by consumer needs and preferences. Although actions are being taken worldwide to reduce plastic use in food packaging, it is still the dominant material used in meat packaging. According to Song et al. [1], biopolymers can meet consumer demands for natural and healthy foods, utilise industrial food waste, and decrease the burden of plastic waste disposal. Edible biopolymer-based films enriched with additional compounds that enhance their antioxidant and antibacterial properties may offer an effective solution to the problem of excessive packaging [1,2].

The purpose of this study was to evaluate the impact of an applied edible film on the formation of biogenic amines (BAS) in poultry meat. A novel, innovative chitosan-based film containing phosphate compounds, approved for use in the meat industry, was proposed. Poultry meat samples were wrapped with edible film, stored in a refrigerator for a week and analysed for the presence of selected BAs (histamine, tyramine, tryptamine, putrescine, cadaverine) and their amino acid precursors. The compounds were determined using HPLC following derivatisation with *o*-phthalaldehyde. The results were compared with those obtained for meat not protected by the edible film.

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SYNTHESIS OF NEW CARBAMATES DERIVED FROM BIOGENIC AMINES AND AMINO ACIDS FOR APPLICATIONS IN FOOD ANALYSIS AND COSMETICS

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Benzyl chloroformate (Cbz) is a popular reagent widely used for protection of amino groups. It is also used in the synthesis of peptides from amino acids for N-terminal protection. This compound was first prepared by Leonidas Zervas in the early 1930s, who used it to introduce a protecting group in the form of stable carbamates.
In the presented studies, the synthesis of biogenic amine derivatives (AB) and their amino acid precursors (AA) with two nitro derivatives of chloroformates was carried out (Figure 1). p-Nitrobenzyl chloroformate and p-nitrophenyl chloroformate were used. All derivatives were obtained in very good yields. They were characterised in terms of spectral and RP-HPLC chromatographic analysis, which was performed using a UV-Vis detector. This allowed us to use the chloroformates we selected as reagents for the synthesis of AB and AA derivatives and use them to analyse AB and AA in selected food and cosmetics samples.

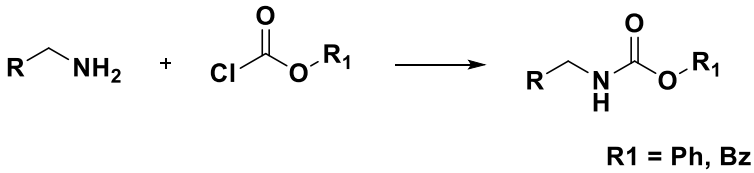

Fig 1. The scheme of synthesis of biogenic amine derivatives with proposed reagents

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INFLUENCE OF SUBSTITUTES OF PYRAZOLOQUINOLINE DERIVATIVES ON THEIR SPECTROSCOPIC AND SENSORY PROPERTIES

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Fluorescent sensors are compounds used for the detection of metal ions. Their operation is based on initially low fluorescence intensity and quantum yield, which increases significantly upon binding with a specific metal ion.

Based on literature sources and our own studies, the spectral and sensory properties of three 1*H*-pyrazolo[3,4-*b*]quinoline derivatives were analysed. These derivatives contain different substituents at the 4-position of the pyridine ring: diethanolamine (PQ1), dipicolylamine (PQ2) and 1-aza-15-crown-5 (PQ3) (Fig. 1) [1-3].

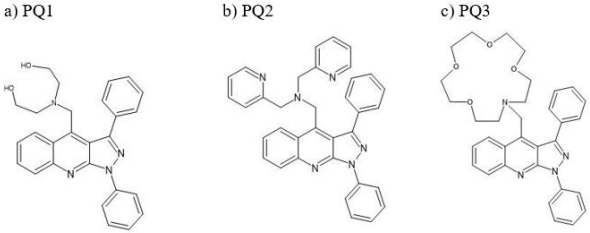

Fig. 1. The structure of PQ1, PQ2 and PQ3 [1-3] .

The results presented here were obtained from studies in which these derivatives were examined upon the addition of aqueous solutions of metal ions: Zn^{2+}, Pb^{2+}, Cd^{2+}, Co^{2+}, Ni^{2+}, Ca^{2+}, Cu^{2+}, Al^{3+}, Cr^{3+} and Mg^{2+}. All compounds were shown to be effective as fluorescent sensors for detecting different metal cations. PQ1 exhibited the best fluorescence response to zinc and lead ions, PQ2 was most responsive to zinc ions, and PQ3 was most sensitive to calcium, cadmium and lead ions. For the PQ1-Zn^{2+}, PQ1-Pb^{2+}, PQ2-Zn^{2+}, PQ3-Pb^{2+} systems, the limit of detection, stoichiometry and binding constants were determined. PQ1 had the best detection limit and high binding constant values for Zn^{2+} and Pb^{2+} ions, although the increase in fluorescence intensity was less significant compared to the other two sensors. PQ2 showed the best selectivity and a good detection limit for Zn^{2+} ions, while PQ3, with the crown moiety, was the least selective.

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FROM STRUCTURE TO FUNCTION: CADMIUM(II) COORDINATION CONNECTIONS CONTAINING IMIDAZOLE IN THE STRUCTURE AS SELECTIVE ANTIFUNGAL AGENTS

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The increasing global incidence of fungal infections poses a rising threat to the lives and health of people worldwide. Unfortunately, there is a growing incidence of resistance to traditional antifungal agents and an increase in the population of immunocompromised individuals who are particularly susceptible to the development of systemic infections, often associated with the genera *Candida*, *Aspergillus*, and *Cryptococcus* [1,2]. Developing a safe and effective antifungal drug is a highly complex process. Mammalian cells are similar to fungi due to significant similarities in their structures and many metabolic processes (eukaryotic organisms). Different studies have shown that cadmium(II) coordination compounds with appropriate ligands show considerable activity against pathogenic, outperform their parent ligands, showing how metal coordination can enhance biological activity [3,4].

The main subject of the study was four imidazole derivatives forming new coordination connections with Cd^{2+} ions. These derivatives differ in inorganic anions in the coordination sphere (Cl^-, Br^-, I^-) and outside it (PF_6^-). The interaction of the obtained compounds with the DNA helix was studied using the switchSense technique. This enabled the analysis of the effect of temperature on the kinetic parameters obtained in the buffer flow. Using the ITC technique, the thermodynamic parameters of the interaction of selected compounds with the Bovine Serum Abumin (BSA) protein were determined. In addition, a preliminary biological antifungal study of the discussed compounds was conducted, which showed their selective activity on selected fungal strains.

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MECHANISM OF ALLOSTERIC ACTIVATION OF HSP70: ATP HYDROLYSIS-INDUCED CONFORMATIONAL CHANGES

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The 70-kDa heat shock protein family (Hsp70) is one of the most ubiquitous and highly conserved classes of proteins in living organisms. [1] As chaperones, Hsp70 play a critical role in multiple cellular processes, including folding of the nascent polypeptide chain, refolding of misfolded proteins, as well as regulation of the protein activity or protein translocation through the membrane. [2] Hsp70 operate in the ATP-dependent manner, consecutively binding and releasing client protein. The catalytic cycle is coordinated by J-domain-containing co-chaperone proteins, which are responsible for both the presentation of a client substrate and the stimulation of Hsp70 ATPase activity. It is known that the ATP hydrolysis in DnaK leads to the rearrangement of the interface formed between Nucleotide Binding Domain (NBD) and Substrate Binding Domain (SBD), eventually leading to detachment of SBD from NBD in the ADP state. [3]

Here, on the example of DnaK- the most extensively studied Hsp70 from *E. coli*- I intend to unveil with molecular detail the mechanism of allosteric coupling within Hsp70 domains with the use of molecular dynamics (MD) simulations. My results provide the description of the DnaK transition from the ATP- to ADP-bound state, both in terms of change of contacts within NBD, as well as the contacts between two domains (Figure 1). Unexpectedly, they highlight the role of non-charged residues in stabilization of NBD-SBD interface including residue Phe216, which may play a central role in inter-domain signal transmition.

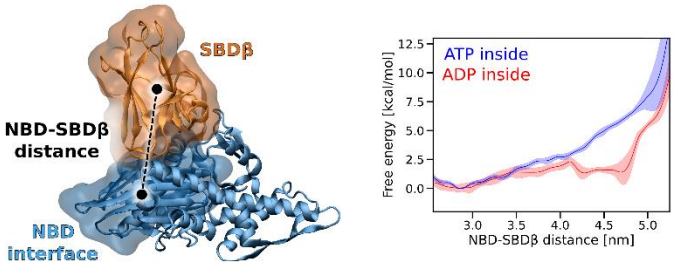

Fig. 1. SBDβ dissociation from NBD in different occupancy of the NBD nucleotide binding pocket. (Left) Schematic representation of the reaction coordinate used in the study. (Right) The free energy profiles for the SBDβ dissociation from NBD.

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INVESTIGATION OF THE MECHANISM, NATURE, AND PROPERTIES OF IRON(III) ION BINDING TO OVOTRANFERRIN (OTF). BIOLOGICAL ACTIVITY OF THE FE-OTF COMPLEX

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Ovotransferrin (OTF) is a protein belonging to the transferrin family, a group of proteins responsible for binding iron ions in various biological matrices. Ovotransferrin constitutes 12–13% of all proteins in hen egg white. It is composed of 686 amino acids, has a molecular weight of approximately 78 kDa, and an isoelectric point of 6.1. This protein exhibits a range of biological functions, including antibacterial [1], antiviral [2], antifungal [3], and antioxidant activities [4].

Metal ions are important modulators of numerous biological processes and are essential for nearly all aspects of metabolism. Iron ions are indispensable for the proper development and functioning of living organisms. Transferrins are capable of maintaining iron metabolism homeostasis by binding and transporting iron ions. Naturally, ovotransferrin like lactoferrin, contains two iron-binding sites (one located on each of the N- and C-lobes), involving the amino acid residues Asp60/395, Tyr92/431, Tyr191/524, and His250/592 for the N- and C-lobes, respectively, along with a CO_3^{2-} anion.

In this study, an attempt was made to investigate the mechanism and nature of Fe-OTF binding. To this end, adsorption isotherm and kinetics studies of iron ions with OTF were conducted. For the adsorption studies, ferric ammonium citrate was used as the source of iron cations. A series of solutions with iron concentrations ranging from 1 to 1100 mg/L were mixed in equal volumes with OTF solutions at a concentration of 5 mg/mL. The amount of iron bound to the protein was determined using Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES).

To further elucidate the nature of binding, spectrophotometric analyses (UV-Vis, FTIR), spectrofluorometric studies, and microscopic observations were carried out. Dynamic Light Scattering (DLS) measurements were also performed to assess the size and zeta potential of the protein as a function of environmental pH. Additionally, molecular docking studies were conducted to visualize the probable iron-binding sites on ovotransferrin.

The applicability of the obtained complexes was evaluated by performing cytotoxicity assays on cell lines and assessing their antioxidant activity.

The study was financially supported by Foundation for Polish Science in frame of Proof of Concept project no FENG.02.07-IP.05-0044/23 "Development of a technology for lactoferrin stabilization with iron ions in the high-efficiency spray drying process"

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STUDY OF THE COMPOSITION AND STRUCTURE OF DX51D SHEET METAL USING SCANNING ELECTRON MICROSCOPY (SEM)

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DX51D steel is a low-carbon grade intended for cold forming, widely used across various industrial sectors, particularly in the construction industry and in the production of lightweight structural components. Due to its high plasticity, favorable mechanical properties, and excellent suitability for cold plastic deformation, DX51D steel is commonly employed in bending, stamping, rolling, and profiling of thin-walled sections and metal sheets. These characteristics make it an ideal material for manufacturing claddings for sandwich panels, which must meet both strength and durability requirements under demanding operating conditions [1-3].

The aim of the conducted study was to analyze the elemental composition of DX51D steel in two states: raw and after the application of a polyester-based protective coating. The purpose of the analysis was not only to identify the elements present but also to assess the effect of the coating process on the microstructure and chemical characteristics of the steel's surface layer. Material samples were subjected to comparative chemical analysis using appropriate spectroscopic methods, enabling the identification of differences in chemical composition and potential interactions between the metallic substrate and the applied coating. The obtained results provide valuable insight into the further application of this steel grade in environments requiring durability, corrosion resistance, and compatibility with protective layers.

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DEVELOPMENT OF NOVEL CURCUMIN-POLYPHENOL CONJUGATES AS POTENTIAL BLADDER CANCER AGENTS

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Cancer remains one of the most pressing global health challenges and is the second leading cause of mortality worldwide, following cardiovascular diseases. According to the GLOBOCAN 2022 global cancer statistical report, an estimated 20 million new cancer cases and 9.7 million cancer-related deaths were reported [1]. Although numerous anticancer agents are currently available, many are associated with significant adverse effects, highlighting the urgent need for novel therapeutics that are less toxic, more affordable, and exhibit minimal side effects [2]. Natural products have emerged as valuable sources in cancer drug discovery due to their structural diversity, multi-target potential, reduced toxicity, and ability to overcome drug resistance. Polyphenols have garnered considerable interest among natural compounds due to their broad spectrum of medicinal properties. Both *in vitro* and *in vivo* studies have demonstrated that polyphenols exhibit anticancer activities through various mechanisms [3].

The primary aim of this study was to synthesize and evaluate novel polyphenol conjugates as anticancer agents of potential use against bladder cancer. Curcumin derivative was selected for conjugation due to its well-documented anticancer, antioxidant, and anti-inflammatory activities. Several curcumin-polyphenol conjugates were synthesized via multi-step synthetic protocols, followed by purification and characterization using analytical techniques such as NMR, HRMS, HPLC, FTIR, and UV-vis spectroscopy. The biological evaluation of these novel compounds, including their anticancer potential and ADMET profiles, is ongoing.

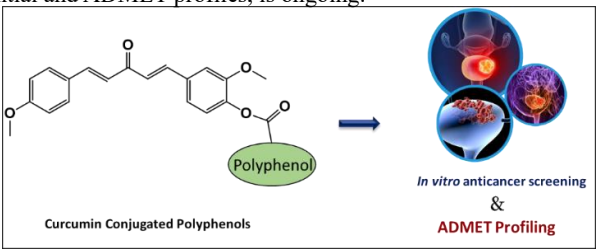

Fig. 1. Synthesis and investigation of novel curcumin conjugated polyphenols as potential anticancer agents.

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APPLICATION OF TITANIUM DIOXIDE AND Ag/TIO$_2$ AND PLASMONIC NANOCOMPOSITES IN LASER DESORPTION IONIZATION (LDI) TECHNIQUES

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Local surface plasmon resonance has become a subject of extensive research due to its potential applications in fields such as optics, electronics, medicine, biological and chemical detection. One of the most important plasmonic materials in the visible and near infrared range are silver nanoparticles (AgNPs). The plasmonic effects of AgNPs have been used for centuries, for example silver nanoclusters determined the color of stained glass windows in medieval cathedrals [1]. Current research focuses on the synthesis of AgNPs with precisely controlled shapes and sizes, which enables tuning of the plasmon resonance and their application in various fields. For example, local increase of the electromagnetic field near the surface of plasmonic nanoparticles results in the improvement of the analytical signal intensity in surface-enhanced Raman spectroscopy (SERS) [2]. Other spectroscopic techniques using the plasmonic effects of AgNPs are laser desorption/ionization techniques, where nanoparticles are used as replacements for conventional matrices. The growing possibilities of applications of silver nanoparticles make plasmonic composites, in which AgNPs are combined with other materials, such as semiconductors, also very popular. Titanium dioxide deserves special attention, which due to its unique optical and semiconducting properties is used in fields such as optoelectronics, photocatalyzation and electrical conversion.

The presented research work focuses on the synthesis of titanium dioxide and Ag/TiO_2 and nanocomposites using chemical vapor deposition (CVD) and atomic layer deposition (ALD), aimed at increasing the analytical performance of laser desorption/ionization mass spectrometry (LDI-MS) for detecting low molecular weight analytes. The obtained systems were also subjected to quantitative analysis using the nanoparticle-assisted laser desorption and ionization (NALDI) technique. This resulted in higher ionization efficiency, which contributed to lowering the limits of detection (LOD) and quantification (LOQ) of the tested compounds and improving the linearity of the response compared to the traditional matrix (DHB).

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SYNTHESIS AND ANALYSIS OF METAL COMPLEXES WITH FLUFENAMIC ACID

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Non-steroidal anti-inflammatory drugs (NSAIDs) are the class of pharmaceuticals with proven analgesic, antipyretic, and anti-inflammatory properties [1,2]. Flufenamic acid (hflu) belongs to group of NSAIDs [3]. It is used in a variety of musculoskeletal and joint disorders [4]. Recent studies indicate that flufenamic acid may have antimicrobial properties and be used as an agent against methicillin-resistant Staphylococcus aureus (MRSA) [5]. Other studies present flufenamic acid as a presumably effective drug with anticonvulsant activity [6]. However, the intake the drug can cause gastrointestinal side effects [7].

Two complexes of Ca(II) and Mg(II) with flufenamic acid were obtained: $Ca(flu)_2 \cdot 3H_2O$; $Mg(flu)_2 \cdot 6H_2O$. The complexes were analysed by flame atomic absorption spectrometry (FAAS); Fourier-transform infrared spectroscopy (FTIR), and thermogravimetric analysis (TG). Additionally to confirm the products of pyrolysis of the complexes the X-ray powder diffraction (XDR) was used. Moreover, the antioxidant properties of synthesized compounds and free ligand were determined.

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POLOXAMER FUNCTIONALIZED WITH GALACTOSE AND DRUGS FOR TARGETED THERAPY OF PRIMARY LIVER CANCERS

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Introduction: Primary liver cancers (PLC) are the fourth cause of cancer-related mortality, with an increasing incidence. The disease is associated with multidrug resistance, leading to disease recurrence and low chances of complete recovery [1]. One promising solution that can mitigate PLC constitutes the preparation of polymer conjugates with pharmaceutically active substances (APIs). Such systems offer the following benefits: (*i*) protection from degradation of API, (*ii*) release of drug in response to biological/environmental factors, and (*iii*) targeting site of action via reporter molecule. Galactose and its derivatives are ligands of ASGPR1, which is mainly expressed in hepatocytes and PLC [2]. **Objective:** To synthesize poloxamers (F127, F68, P123, L64 and L31) functionalized with drugs and targeting moieties. **Materials and Methods:** Drugs and monosaccharides were used either protected or unprotected. End groups of poloxamers were modified using linkers such as succinic acid or glycine. Reactions including Steglich esterification, Fischer glycosylation, and oxazoline ring opening were employed for altering unprotected sugars. In the case of protected sugars, poloxamers were first functionalized with succinic acid or 1-bromopentane and then coupled via Steglich esterification or Williamson ether synthesis, respectively. Fully protected sugars like peracetylated galactose were reacted in the presence of Lewis acid catalysts such as $SnCl_4$ or BF_3. A similar strategy was used for drug conjugation. APIs, including 5-fluorouracil, either directly or via linkers. The synthesized products were purified using precipitation, ultracentrifugation, and membrane separation techniques. Product structures were confirmed by nuclear magnetic resonance (NMR) spectroscopy. **Results**: A range of block copolymers functionalized with galactose and its derivatives, and various linkers, was successfully synthesised. NMR analysis verified the structures and allowed estimation of the degree of modification, which ranged from 20% to 100%, depending on the polymer's molecular weight and the nature of the substituent. **Conclusions**: Poloxamer conjugates with galactose derivatives were successfully obtained and will be further studied as carriers for targeted drug delivery based on polymeric micelles.

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DESIGN, SYNTHESIS AND BIOASSESSMENT OF FUNCTIONALISED MONO-SPIRO-1,2,4,5-TETRAOXANES

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A large group of diseases in which fast-dividing abnormal cells can invade or affect any organ or tissue of the human body is termed '*cancer*'. Cancer remains a leading cause of death, and worldwide cancer-related mortality is reported to have reached 10 million in 2020 [1]. The most common cancer treatment protocol is '*Chemotherapy*', often abbreviated as 'chemo' or CTx, which utilizes one or more powerful anticancer medications to suppress cancer cell multiplication in the human body. The limitations frequently associated with classical chemo, such as severe immunity-related issues, fast-emerging drug resistance and post-chemo long-term gastrointestinal side-effects, have urged the search for novel targeted anticancer drugs [2]. Since nature-inspired smaller monomers are a rich source of chemotherapeutics and offer various advantages in cancer treatment [3]. Therefore, the (MTO)-catalysed two-step one-pot approach was used, and a library of mono-spiro-1,2,4,5-tetraoxanes (**4a-m**) has been selectively prepared in a 21-87% yield range. Different chromatographic and spectral analysis techniques, such as HPLC-UV, ^{1}H NMR, ^{13}C NMR and mass spectrometry, have been utilized, respectively, for the purity and structural elucidation of the resulting molecules. All the synthesized aryl-substituted mono-spiro-1,2,4,5-tetraoxanes (**4a-m**) were subjected to *in vitro* cytotoxicity assessment against the A549 (lung) and A2780 (ovarian adenocarcinoma cells, respectively. The MTT assay technique was used for bioassessment. The initial findings have confirmed the strong micromolar cytotoxic potency of mono-spiro-1,2,4,5-tetraoxanes (**4a-m**) against lung and ovarian cancer cells.

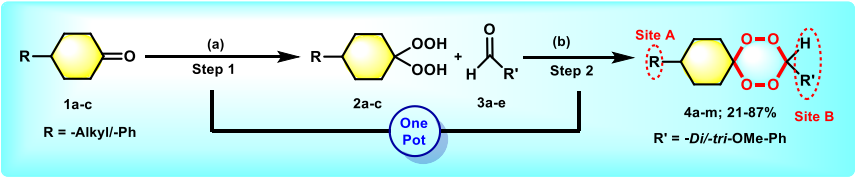

Fig. 1. Classical two-step one-pot approach for functionalised mono-spiro-1,2,4,5-tetraoxanes (**4a-m**) syntheses.

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THIOAMIDE-FUNCTIONALIZED TETRAHYDROCARAZOLES AS POTENTIAL ANTICANCER AGENTS

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The poster presents research related to the synthesis of new heterocyclic derivatives based on the tetrahydrocarbazole core, which exhibit strong anticancer activity. Using Fischer indolization, we synthesized the desired structures and evaluated their biological activity [1]. Two thioamide compounds demonstrated potent cytotoxicity against cancer cell lines (MCF-7, HCT116, A549). These compounds inhibit cell growth, alter cell morphology, reduce colony formation and adhesion, and disrupt the cell cycle and mitochondrial function, ultimately inducing apoptosis. Additionally, they impair angiogenesis [2], These findings open new avenues for the development of future anticancer drugs.

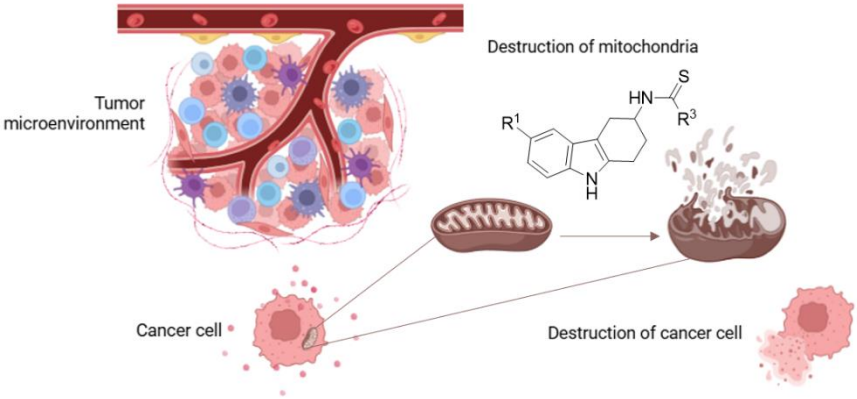

Fig. 1. Anticancer effect of thioamide derivatives of carbazole.

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UNLOCKING THE POTENTIAL OF FERMENTED FOOD EXTRACTS: FATTY ACIDS AND MINERALS PROFILING

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Fermented foods represent a valuable source of biologically active compounds, including a diverse range of fatty acids and essential minerals [1]. In this study, we highlighted the rich lipid profiles of various fermented food extracts, emphasizing the presence of both saturated and unsaturated fatty acids, including health-promoting polyunsaturated fatty acids (PUFAs). Additionally, we profiled key minerals such as calcium, magnesium, zinc, and iron, demonstrating that fermentation significantly influences their concentration in the extracts. The fermentation process not only enhances the bioavailability of these fatty acids but may also induce beneficial modifications in their composition, contributing to improved nutritional quality [2].

This study aimed to perform a comprehensive profiling of fatty acids and essential minerals in plant-based fermented extracts obtained using modern extraction techniques, including supercritical fluid extraction (SFE), accelerated solvent extraction (ASE), and traditional maceration from both lyophilized and conventionally dried fermented materials. Gas chromatography with flame ionization detection (GC-FID) was employed for the detailed identification and quantification of fatty acids [3]. The mineral profile—specifically sodium (Na), potassium (K), calcium (Ca), magnesium (Mg), iron (Fe), and zinc (Zn)—was determined using inductively coupled plasma mass spectrometry (ICP-MS) to assess their concentrations and bioavailability in the extracts.

The concentration and composition of fatty acids and minerals varied significantly depending on the drying method and extraction technique employed. Supercritical fluid extraction (SFE) consistently yielded extracts with higher antioxidant potential and enhanced fatty acid recovery, particularly for thermolabile PUFAs.

Our findings position fermented food extracts as potent functional ingredients, capable of delivering targeted health benefits through their enriched profiles of bioactive fatty acids and essential minerals. By demonstrating how advanced extraction techniques and drying methods influence the nutritional and functional properties of plant-based fermented materials, this study unlocks new opportunities for innovation in nutritional science, functional food development, and personalized dietary interventions aimed at promoting human health.

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SECTION OF BIOLOGICAL AND MEDICAL SCIENCES
ORAL PRESENTATIONS

EVALUATION OF THE BARRIER PERFORMANCE OF COMPONENTS PRESENT IN OROMUCOSAL PREPARATIONS

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Oral mucosal diseases are a common social problem affecting patients in all ages. Oral tissues are exposed to mechanical injuries and constant contact with pathogens [1]. In recent years, there has been an increase in a number of preparations available for alleviation of the course and the treatment of oral mucosal diseases. These products are often claimed to form a protective layer upon application, evenly covering the mucosal tissue. This barrier function helps to relieve the pain and promote the healing processes. Since to our best knowledge there is a limited data on assessing the barrier performance of oromucosal preparations.

Therefore, the aim of this study was to evaluate the barrier efficacy of main polymer components (polivinylpirolidone (PVP), xanthan gum (XA) and hyaluronate sodium (HA)) present in selected commercial oromucosal preparation (Anaftin® - control) using in vitro permeability and texture assay. For this purpose, three gel formulations (comprised of each polymer dispersed in water/glycerin base) with viscosity values corresponded to those attained for commercial oromucosal preparation (control) were prepared by homogenization technique. Permeability tests were performed in in-line cell system equipped with thermostated diffusion chambers (SES GmbH Analysesysteme). Hydrophilic caffeine characterized by high permeability was selected as model chemical agent [2]. Measurements of firmness, consistency and cohesiveness were carried out with texture analyzer TA.XT.Plus [3] and scanning electron microscopy was performed by SEM Inspekt S50. Quantitative analysis was performed by high-performance liquid chromatography using Agilent Technologies 1200.

Substantial differences were observed in caffeine permeability among tested polymers. Basically, XA and HA demonstrated the highest barrier efficacy as the total amount of permeated drug was approximately 40-fold lower than that of control. In addition, the presence of chemical agent in acceptor fluid was noticed upon 2h and 1h of test, respectively. The obtained values corresponded with data from texture and SEM analysis in which the firm structure with high dense porosity was noticed for these polymers. In turn, the PVP formulation favored caffeine penetration and the presence of drug in acceptor medium was observed within first 15 min of study. Interestingly, control preparation comprising all three polymers exhibited the highest rate of drug diffusion among tested suggesting the presence of PVP may weaken the protective properties of XA and HA.

Overall, the attained data demonstrated favorable potential of XA and HA but no PVP as polymers with barrier function against hydrophilic chemicals. However, further studies are needed to understand the relationship between three-dimensional structure and barrier function.

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ANALYSIS OF POLYP AND DNA INTERACTIONS WITH SELECTED PROTEINS

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Spatial separation within bacterial cells affects metabolic pathways by creating distinct local environments for proteins. One form of such compartmentalization may arise from condensates of polyphosphate (PolyP), resulting in the assembly of membraneless organelles called 'PolyP granules' [1]. PolyP is a linear polymer consisting of up to 1,000 phosphate residues linked by ATP-like, high-energy phosphoanhydride bonds. Polyphosphate kinase (PPK) catalyzes the conversion of the terminal (γ) phosphate of ATP into PolyP [2], while exopolyphosphatase (PPX) hydrolyzes the terminal residues of PolyP to release inorganic phosphate (Pi) [3]. PolyP is conserved across all domains of life and is mainly synthesized under various environmental stresses, playing a key role in cellular survival [4]. Moreover, it can substitute for ATP in kinase reactions, act as a reservoir of inorganic phosphate (Pi), and chelate divalent metal ions such as Mg^{2+} and Ca^{2+} [5]. Although some PolyP-binding proteins have been described in the literature, the structure, composition, and function of PolyP granules remain incompletely understood. Furthermore, the molecular mechanisms governing their assembly and disassembly have yet to be elucidated.

Our main hypothesis posits that PolyP may serve as an alternative scaffold for a number of proteins typically associated with DNA. Thus, it could alter the spatial distribution of protein activity, potentially leading to changes in their function.

To investigate this, I compared the interaction of selected proteins with PolyP versus DNA using Electrophoretic Mobility Shift Assay (EMSA) and Bio-Layer Interferometry (BLI). These comparative analyses address a key question: *How competitive is PolyP in binding DNA-associated proteins?* Additional experiments I performed provide insights into the PolyP–protein assemblies. Using Atomic Force Microscopy (AFM), I demonstrated which proteins influence the formation and maturation of PolyP condensates. By acting as a granule-forming scaffold for proteins, PolyP could play a pivotal role in shaping bacterial metabolism and coordinating responses to environmental challenges.

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EFFECTS OF GLYCOALKALOIDS ON THE RETROCEREBRAL COMPLEX IN *TENEBRIO MOLITOR* BEETLE

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Synthesis of the secondary metabolites is a basic plants' protective mechanism [1]. Glycoalkaloids are one of these secondary metabolites, which are produced in eatable parts of plants, leaves, flowers, roots and sometime even in sprouts[2]. They exert diverse effects on insects – from cellular and tissue levels to the entire organism [3]. α-solanine and α-chaconine constitute 95% of all glycoalkaloids present in the leaves and tubers of the potato plant *Solanum tuberosum* [4]. The mechanism of toxicity induced by α-solanine and α-chaconine probably is associated with their membrane-disruptive properties and their inhibition of acetylcholinesterase activity [5].

Adult *Tenebrio molitor* beetles, a model species commonly used in insect physiology research, were injected with α-solanine and α-chaconine solutions at two concentrations: 10^{-5} and 10^{-7} M. To determine the toxicity of the tested glycoalkaloids, survival assays were performed at the initial stage of the experiment. Subsequently, using light microscopy, we assessed their effects on a key neuroendocrine structure – the retrocerebral complex (corpora cardiaca and corpora allata) – at three time points: 24, 48, and 72 hours post-injection.

The glycoalkaloid-induced changes in morphology of the corpora cardiaca and corpora allata may impair their functional activity. This could lead to significant disruption of *T. molitor* physiology, including reproduction, and ultimately contribute to a decrease in their population [6].

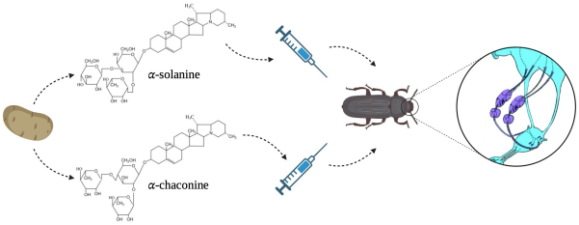

Fig. 1. α-solanine and α-chaconine from *Solanum tuberosum* were injected into adult *Tenebrio molitor* beetles to assess their effects in the retrocerebral complex.

Research supported by grant No. 2023/51/B/NZ3/01550 from the National Science Centre, Poland

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MICROBIOLOGICAL ASSESSMENT OF PROBIOTIC PRODUCTS: QUALITY AND CONTAMINANT ANALYSIS

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Probiotics are defined as live microorganisms that, when administered in adequate amounts, provide health benefits to the host. However, scientific evidence supporting the efficacy of commercially available probiotics remains limited. Despite this the growing popularity of probiotics can be observed in recent years. In Poland, most probiotic products are registered as dietary supplements or foodstuffs. This classification does not require rigorous regulatory oversight. This raises concerns about product consistency, microbial viability, and potential contamination [1, 2].

The aim of this study was to assess the microbiological quality and detect contaminants in commonly sold probiotic preparations.

Five commercially available probiotic products were analysed. For quantitative evaluation, the contents of three capsules from each product were diluted and cultured on MRS agar under anaerobic conditions (5% CO_2, 37°C, 72 hours). To detect contamination, the lowest dilution of each sample was inoculated on sheep blood agar (5%), MacConkey agar and Sabouraud dextrose agar. In addition, the capsules surface contamination was assessed. Microbial identification was performed using matrix-assisted laser desorption/ionisation time-of-flight mass spectrometry (MALDI-TOF).

Results revealed significant variability in product quality. Only two out of five formulations contained viable bacterial counts exceeding 10^9 CFU/mL. Notably, one product exhibited no growth of the declared probiotic strain in two out of three capsules. While no fungal or Gram-negative bacterial contaminants were detected within capsule contents, *Debaryomyces hansenii* was identified on the surface of capsule of one product. Furthermore, MALDI-TOF MS analysis confirmed discrepancies between labeled and actual microbial compositions. Not all probiotic bacteria strains were identified.

This study confirms previous findings that the quality of probiotics in dietary supplements varies considerably, with cases of undeclared strains or the complete absence of labelled microorganisms. Products registered as medicines are subject to much more rigorous quality control than dietary supplements, which often do not undergo such detailed testing. The use of preparations with documented composition and dosage is crucial, especially in the paediatric population [3–6].

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WHICH DIETARY SUPPLEMENT CONTAINING *SACCHAROMYCES BOULARDII* IS BEST TO USE? AN EVALUATION OF PROBIOTIC PRODUCTS AVAILABLE IN PHARMACIES

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Introduction*: Saccharomyces cerevisiae var. boulardii* is an unique, non-bacterial probiotic yeast that has demonstrated significant therapeutic potential across a range of gastrointestinal (GI) and systemic conditions. Notably, *S. boulardii* shows efficacy in the prevention and treatment of *Helicobacter pylori* infections, various forms of diarrhea (e.g., *Clostridium difficile* infection, antibiotic-associated, and traveller's diarrhea), inflammatory bowel disease, irritable bowel syndrome, candidiasis, dyslipidemia [1,2]. Therefore, *S. boulardii* found use as dietary supplement. However, they also should meet the requirements and regulations concerning additives, chemical and microbiological contaminants, residues in foodstuffs of chemicals used in the cultivation, protection, storage and transportation, and labeling regulations, including nutrition and health claims. The prime objective of this research was to evaluate validity which among the available probiotic diet supplements (Enterotravel, DrEntero, Kolonobiotic IBS, Florcontrol) available in pharmacies meet those requirements and manufacturer's claims.
Methods: 1) Identification of isolates cultured from chosen diet supplements by MALDI-TOF method. (2) A series of serial dilutions of the probiotic preparation were performed under sterile conditions to assess viable yeast counts. Quantitative cultures were conducted by plating the dilutions on Sabouraud Agar and Columbia Blood Agar media to evaluate colony-forming units (CFUs).

Key results: From one probiotic Kolonobiotic IBS from inside the capsule the authors managed to culture few strains: *Bacillus sonorensis, Bacillus subtilis* and *Micrococcus luteus* besides declared by the manufacturer *S. boulardii.*

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NEXT-GEN PLANT-BASED FOODS: PHYSICOCHEMICAL AND MOLECULAR EVALUATION OF VEGAN PÂTÉS

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The pursuit of sustainable and ethical dietary alternatives has led to a significant rise in the development of plant-based meat alternatives. This study focuses on the comprehensive evaluation of three types of vegan pâtés, formulated using pea, sunflower, and rice proteins. The research used analytical techniques to establish their physicochemical properties, water dynamics, and molecular behavior [1].

The pâtés were prepared using the same formula and method of preparation to achieve similar moisture and protein contents. Key physicochemical parameters, including color, texture, water activity, and total water content, were analyzed to assess product quality. Color measurements were performed using the CIE L*a*b* analysis, providing an objective evaluation of appearance. Texture analysis was conducted to measure firmness, cohesiveness, and elasticity, offering insights into the sensory experience.

Water properties were investigated through water activity measurements, which determine the microbiological stability and shelf-life of the products [2]. Total water content was quantified to provide additional insights into the hydration levels of each formulation. Advanced low-field nuclear magnetic resonance (LF NMR) spectroscopy was used to establish water mobility and distribution within the pâté matrices [3].

Fourier-transform infrared (FTIR) spectroscopy was employed to characterize the molecular composition of the samples [4]. This technique provided information on the functional groups present, including protein structures and interactions with other components such as lipids and carbohydrates. Sensory and consumer testing have been carried out to show the gap between laboratory analyses and market success.

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VIRULENCE GENES IN *ENTEROCOCCUS* SPP. ISOLATED FROM WASTEWATER TREATMENT PLANTS

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The genus *Enterococcus* comprises Gram-positive, non-spore-forming cocci with low nutritional requirements. In wastewater treatment plants, *Enterococcus* spp. demonstrate exceptional adaptability to harsh technological conditions: resistance to periodic desiccation in sludge, the ability to grow at high salinity, and tolerance across a broad pH and temperature range. Moreover, they resist commonly used disinfectants and elevated ammonia concentrations, enabling effective colonization of activated sludge, pipes, and retention tanks, where they form persistent biofilms and survive fluctuating physicochemical parameters of the treatment process [1].

The aim of this study was to determine the frequency of virulence genes in vancomycin resistant *Enterococcus faecium* (VREfm) strains isolated from a wastewater treatment plant. The material for the study consisted of 74 strains. Species identification of isolated strains was performed using MALDI- TOF MS technique. The genetic material of the bacteria was extracted using a thermal method, and multiplex PCR were used to screen for the presence of selected virulence genes. The study evaluated the presence of the aggregation substance (*agg*), gelatinase (*gelE*), enterococcal endocarditis antigen (*EfaAfs*) and collagen-binding adhesin (*ace*). The *E. faecalis* ATCC29212 strain was used as positive control. Tested strains harbored virulence-associated genes with the following frequencies: *agg*: n = 18 (24 %) *gelE*: n = 24 (32 %), *EfaAfs*: n = 16 (22%), *ace*: n = 25 (34 %). Our results indicate that wastewater treatment plants serve as reservoirs of VREfm strains carrying key virulence determinants. The high prevalence of a*gg, gelE, EfaAfs*, and *ace* suggests these bacteria possess strong abilities to adhere to surfaces, degrade host proteins, and colonize biotic and abiotic interfaces [2]. Consequently, potentially pathogenic isolates may be released into aquatic environments with treated effluent or via sludge dispersal, posing an infection risk to humans upon contact with contaminated water or its use in municipal and industrial processes.

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EXPLORING GENETIC VARIANTS IN ASTHENOZOOSPERMIA: NEW FINDINGS FROM CONSANGUINEOUS FAMILIES

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Asthenozoospermia (AZS) is a common cause of male infertility. Genetic diagnosis technologies are crucial to uncover novel genetic variants causative of AZS [1]. Consanguineous families offer valuable genetic data with enhanced accuracy in genomic analysis [2,3]. We performed whole genome sequencing (WGS) on three Pakistani consanguineous families samples (n=15) with both affected and unaffected individuals with male infertility: AZS, severe oligoasthenozoospermic (OAT), fertile males, and parental carriers. We targeted rare nonsynonymous, nonsense, or frameshift variants (gnomAD VAF<0.01). We assessed the variant pathogenicity using prediction tools and verified the testis-specific gene expression and the link to male fertility. In family I, we identified a deleterious homozygous variant in all the individuals with AZS in *DNAH12* (c.7558C>T), crucial for the structure and function of cilia and flagella. We also identified a deleterious AR gene variant (c.188T>C), as well as a deleterious variant in *ZMYM1* (c.2741A>T) in the patient with severe OAT, which we suggest are responsible for the phenotype. In family II, we identified a stop-gain variant in the AZS individuals in *CFAP70* (c.2335C>T), crucial for the regulation of dynein arms and microtubule structure. In the patient with severe OAT necrozoospermia, we uncovered a missense variant in *GLIS2*, which may play a crucial role in the apoptotic process induced in germ cells, thus this variant may be causative of the necrozoospermia in this individual. Finally, in family III, in one AZS individual we identified de novo variants in *DYNC1LI2* (c.584del) and *CFAP54* (c.8334+3del), both of which are essential for sperm flagella and sperm motility. While the other AZS individual carried a missense variant in *G6PD* (c.563C>T), the first component of the penthose pathway, which is suggested to be important for sperm motility. Our findings emphasize the role of dynein arm assembly in AZS.

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CHLOROPLAST INSERTIONS IN PLANT NUCLEAR GENOMES

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The development of DNA sequencing and genome assembly methods has been very dynamic in recent years. This has led to the development of nuclear and organellar reference genome sequences of many plant species. Detailed analyses of plant nuclear genomes have shown that they contain nucleotide sequences typical for chloroplast genomes, referred to as NUPT (nuclear-encoded plastid DNA) [1]. The presence of these sequences in nuclear genomes poses a serious challenge in the processes of their assembly [2].

The aim of this study was to determine the scale of the occurrence of NUPT sequences in the nuclear genomes of selected plant species. For the study, 243 plant species belonging to 25 families of the kingdom Virdiplantae were selected. Using BLAST bioinformatics tools, the number and the length of chloroplast inserts in nuclear genomes were examined [3]. The average size of NUPT inserts was 2319.5 bp (median 425.0 bp). The number of NUPT insertions in the nuclear genomes of individual species ranged from 4 to 37407, while the total length of these sequences was highly variable, from 2284 bp in *Capsella grandiflora* to 98195767 bp in *Vigna Mungo*. The percentage share of NUPT sequences in nuclear genomes varied widely from 0.00157% in *C. grandiflora* to 6.69% in *Eucalyptus regnans*. One species (*V. mungo*) was also noted that significantly differed from the general data with a NUPT content of 20.5%. The positive relationship was shown between the total size and number of chloroplast inserts and the size of nuclear genomes. It was verified whether the observed presence of chloroplast inserts is related to the method of DNA sequencing of the nuclear genome. During the analyses, sequences flanking chloroplast inserts in the 50-bp nuclear genome were also examined.

Further studies will aim to determine the patterns of NUPT sequence distribution in different parts of the nuclear genome and to identify the origin of these sequences in the chloroplast genome, as well as to analyse similarities and differences between species in the context of their phylogenetic position. The results of the conducted research will be helpful in the analysis of the organization of plant genomes and in improving the procedures for assembling plant nuclear genomes.

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FEEDING DISORDERS IN CHILDREN AND THE RISK OF MALNUTRITION AND DIET-RELATED NON-COMMUNICABLE DISEASES

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In the case of humans, the first programmed way of feeding is breastfeeding. As time passes and the child develops, changes occur in the diet, the feeding process, and the child's behavior towards food. All these elements have an impact on health status - both present and future [1]. Feeding disorders in children do not have one strictly defined definition that would be commonly used. However, they are defined as improper food intake, inappropriate for age, which is associated with nutritional, medical and psychosocial factors, it is a problem that requires an interdisciplinary approach [2]. They may have a behavioral basis, be the result of medical causes or occur in a mixed form. Disorders in the form of food neophobia, food selectivity, limited appetite and food aversions can be distinguished [3]. Feeding disorders most often occur in children between the 1st and 3rd year of life, but their consequences may reach into later life and cover different areas of life [4]. It should be considered that nutritional behaviors established in early life may persist throughout childhood [5]. These disorders are associated with the risk of improper nutrition. They can lead to many deficiencies and disorders in development and nutrition disorders in later life [6]. Food selectivity resulting from limited consumption of vegetables, fruits, nuts and legumes may lead to consumption of highly processed food. These are fast food products, sweets - food typical of the Western model of nutrition. This in turn predisposes to the occurrence of non-communicable diseases in adulthood. Such a diet does not provide the recommended nutrients and carries the risk of health problems and disorders in the child's development [7]. A relationship between food neophobia and increased body mass index - BMI has also been observed [8]. Feeding disorders in children are a complex problem, the proper identification of which is crucial for the proper development of the child.

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ASSESSMENT OF THE SUSCEPTIBILITY OF *CLAVISPORA LUSITANIAE* (SYN. *CANDIDA LUSITANIAE*) TO MANOGEPIX AND AMPHOTERICIN B

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Introduction: The higher number of fungal infections is related to an increase in the number of patients under immunosuppression and the increasing resistance of various species to classical antifungal drugs, such as *Clavispora (Candida) lusitaniae*. Limited data on the drug susceptibility of this species is available in the EUCAST database, therefore it is crucial to conduct research in this area [1]. Reliable results on the efficacy of antifungal therapy are lacking, making it difficult to develop comprehensive treatment recommendations. This gap in available information challenges researchers to accurately determine the susceptibility profile of *C. lusitaniae*, which may be crucial in the context of the growing drug resistance of this pathogen. Fosmanogepix is a prodrug in a new class of antifungal drugs whose active metabolite is manogepix. The drug is currently in phase III clinical trials and has shown broad activity against many species of fungi, including *Candida auris* [2]. *Clavispora lusitaniae* is a species considered naturally resistant to amphotericin B, therefore the prime objective was to validate the susceptibility od clinical strains to amphotericin B as well as the new drug manogepix.
Material: 28 isolates from various clinical materials of *Clavispora lusitaniae isolated from* from University Clinical Hospital in Wroclaw.

Methods: (1) Identification of clinical isolates of *Candida spp* using the MALDI-TOF method. (2) Evaluation of susceptibility of *Clavispora lusitaniae* to amphotericin B and to manogepix with EUCAST reference microdilution method.
Results: MIC range was 0.01 – 0.125 mg/L for manogepix, as far as amphotericin B is concerned only three strains had MICs of 0.25 µg/ml, while the vast majority - 18 strains - reached 0.5 µg/ml. A value of 1 µg/ml was found in 7 strains,. According to the EUCAST-established cut-off values (ECOFF) 21 of 28 strains were classified as wild-type.

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TACHYKININ-RELATED PEPTIDES AS REGULATORS OF THE REPRODUCTIVE SYSTEM IN FEMALE *TENEBRIO MOLITOR* L. – A POTENTIAL TOOL IN INSECT REARING AND PLANT PROTECTION

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In the face of a growing global population and the need for sustainable food production, edible insects are gaining importance as an alternative source of nutrients, including protein. *Tenebrio molitor* (yellow mealworm) is one of the key species used in industrial farming due to its rich and diverse chemical composition and low environmental requirements [1]. Optimizing the reproductive cycle of this species is a crucial aspect of increasing the efficiency of insect protein production.

Among the most important regulators of vital processes in insects are neuropeptides, including tachykinin-related peptides (TRPs), which, similarly to vertebrates, may play a key role in regulating the reproductive system [2-3]. Our research has demonstrated a correlation between the expression of *Tenmo-TRP* and the expression level of the gene encoding vitellogenin—a glycolipoprotein that serves as the main energy source for the developing embryo. These findings suggest that TRPs may influence the functioning of the reproductive system in female *T. molitor*. Application of this neuropeptide also increases the number of eggs laid, leads to an increase in the size of the terminal oocyte, and improves the patency of the follicular epithelium in the ovaries. Notably, the use of RNAi to silence the gene encoding the TRP precursor results in the opposite effect, which may indicate a direct influence of TRP on fertility.

The results obtained provide a promising basis for the development of strategies aimed at both optimizing the breeding of edible insects and creating selective methods for controlling populations of economically harmful insect species.

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THE ROLE OF SUBINHIBITORY CONCENTRATIONS OF TIGECYCLINE IN MODULATING THE EXPRESSION OF EFFLUX AND REGULATORY GENES IN *ENTEROBACTER CLOACAE* COMPLEX STRAINS

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The emergence of tigecycline resistance among *Enterobacter cloacae* poses a significant challenge in the treatment of infections caused by multidrug-resistant Gram-negative bacteria. Subinhibitory concentrations (sub-MICs) of antibiotics, frequently encountered in clinical settings, are known to modulate bacterial gene expression and may contribute to the development of resistance.

This study aimed to evaluate the expression of key efflux-associated genes (*acrA*, *acrB*, *tolC*) and regulatory genes (*ramA*, *marR*, *marB*, *soxS*) in clinical *Enterobacter cloacae* isolates exposed to sub-MIC levels of tigecycline. A total of 48 isolates were analyzed using RT-qPCR following incubation with tigecycline at ½ MIC.

The results revealed that the majority of tigecycline-resistant strains exhibited significantly increased expression of the regulatory genes, particularly *ramA* and *marB*, in response to subinhibitory tigecycline exposure. In several cases, this upregulation correlated with elevated expression of efflux pump components, suggesting a regulatory cascade enhancing efflux activity under antibiotic pressure.

These findings indicate that even low, non-lethal concentrations of tigecycline may trigger adaptive genetic responses promoting resistance in *Enterobacter cloacae*. Understanding such mechanisms is essential for optimizing antibiotic use and preventing the selection of resistant strains.

POTENTIAL MECHANISM OF LYMPHOID CELL DEATH INDUCED BY ANTI-MHC II ANTIBODIES

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The development of monoclonal antibodies (mAbs), targeting cancer-specific antigens and inducing apoptosis of cancer cells is crucial for the advancement of hematological malignancies therapy. The majority of monoclonal antibodies with therapeutic potential need the complement activation or antibody-dependent cellular cytotoxicity for eliciting their anticancer activity [1-2].

In our institute it has developed two monoclonal antibodies, B5 and E11, that recognise antigen DLA-DR (canine MHC II) which exert strong direct and indirect apoptotic effect on canine leukaemia and lymphoma cell lines [3].

The aim of presented research is to investigate the molecular mechanism of apoptosis in cells treated with anti-DLA-DR antibodies. I study the hypothesis that apoptotic effect is not dependent from internalization, but is associated with signal transduction into the cell. Understanding the molecular mechanism of the anti-tumor activity of MHC II mAbs is vital to advance their application both in dogs and humans.

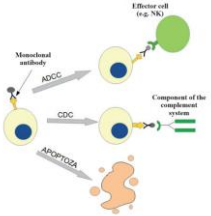

Fig. 1. Indirect and direct cytotoxicity of monoclonal antibodies.

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BIOLOGICAL EFFECTS OF LONG-TERM EXPOSURE OF *DROSOPHILA MELANOGASTER* AND *D. SUZUKII* TO SUBLETHAL DOSES OF THE NEONICOTINOID ACETAMIPRID

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Currently, the most commonly and most frequently overused insecticides in crop protection are neonicotinoids. This is a relatively new group of nicotine-derived compounds that have been introduced to the market as an alternative to previously used, environmentally harmful insecticides. In general, neonicotinoids are safe for the environment and non-target organisms (e.g. mammals) because they are selective for nicotinic acetylcholine receptors in the insect nervous system (nAChR). They cause excessive stimulation of nerve synapses, paralysis and death of pests.
These compounds are water-soluble, so their presence is not limited to the application sites, and increased concentrations of neonicotinoids are detected in the entire environment, including fruits, vegetables, and honey [1]. This means that they are unintentionally included in food, which makes them potentially dangerous to other organisms, including humans [2].

The study concerned the effects of long-term exposure to sublethal doses of the neonicotinoid acetamiprid on two insect species: *Drosophila melanogaster* Meingen (1830) – a model organism used in broadly understood biological research and *Drosophila suzukii* Matsumura (1931) – a polyphagous invasive species originating from Southeast Asia, which in the last decade has colonized over 20 countries in Europe and both Americas [3]. *D. suzukii* is a pest mainly of berries, such as blueberries and cherries, but also of wild fruits, including forest fruits. One of the insecticides approved and recommended for use in reducing the population of *D. suzukii* is acetamiprid N-(6-Chloro-3-pyridylmethyl)-N′-cyano-N-(methyl-d3)acetamidine.
The effects of neonicotinoid on insects were analyzed at the behavioral, organismal and cellular levels and the effects of long-term exposure to acetamiprid were compared between two closely related phylogenetically insect species.

Acetamiprid at low, sublethal doses was found to reduce the survival and fertility of insects, damage the DNA of larval neuroblasts, disrupt insect locomotor activity [5] and disrupt developmental stability, which was observed as the appearance of fluctuating asymmetry of wing venation. It was found that insects of the species *D. suzukii* show greater sensitivity to acetamiprid.

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THE INFLUENCE OF STRESS-INDUCING FACTORS ON THE VIABILITY OF MURINE FIBROBLAST L929 CELL LINE

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Background. Our bodies most outward facing epithelial barrier, the skin, serves as the frontline defense against myriad environmental assailants [1] such as temperature, ultraviolet radiation, mechanical damage, pathogens, chemicals and physical fields like magnetic field (MF). Fibroblasts play a crucial role by maintaining extracellular matrix integrity [2], regulating wound healing and modulating local immune responses [3] to stress-inducing factors. This has led to increased interest in physical factors that could modulate fibroblasts activity, particularly MF, which are now being explored as potential non-invasive therapeutic tool. Research suggests that the application of MF can enhance wound healing in skin, resulting in significantly increased tissue strength [4] and may even promote neural cell repair in the brain, as corroborated in human studies [5]. Investigating the effects of MF on skin cells is crucial, as the successful enhancement of the innate functions of mammalian cells could facilitate the development of safe, non-invasive, drug-free approaches to improve tissue repair or skin regeneration.

Aim. This study aimed to explore the impact of MF with varying frequencies and waveforms on L929 murine fibroblasts.

Methods. L929 murine fibroblasts were cultured (0.3×10^6 cells/dish) in DMEM for 24 h (37ºC, 5% CO_2) for cell adhesion. After incubation, DMEM was aspirated, cells washed, and fresh DMEM added. Cells were exposed to MF for 1 h using sine and triangle waveforms at 5, 50, and 2000 Hz. Control cells were incubated without MF. After exposure, cells were washed, detached, centrifuged, and resuspended in DMEM. Three assays evaluated cell viability (LIVE/DEAD assay), metabolic activity (AlamarBlue assay) and morphological changes (via an inverted microscope).

Results. Results indicated that frequency and waveform influenced cell viability, metabolic activity and morphology. The highest tested frequency (2000 Hz) was associated with lower fibroblast cell viability compared to the lower tested frequencies (5 and 50 Hz). The sine wave resulted in higher viability compared to the triangle wave. Metabolic activity was inhibited at the highest tested frequency, while stimulated at the lower and the triangle wave had a stronger inhibitory effect compared to sine wave. At the highest tested frequency, cells showed reduced spreading and were less elongated regardless of waveform. Other frequencies did not elicit visible morphological changes.

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INFLUENCE OF BODY COMPOSITION ON ACOUSTIC VOICE CHARACTERISTICS IN A GROUP OF PERI- AND POSTMENOPAUSAL WOMEN

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The primary determinants of acoustic characteristics encompass not only gender and age but also body size and morphology [1]. Prior research has established a correlation between acoustic parameters and body size, indicating that individuals with greater height and larger body dimensions typically exhibit lower-pitched voices [2]. However, the extant literature is deficient in addressing body composition, which provides a more nuanced understanding compared to the conventional Body Mass Index (BMI).

This presentation aims to disseminate the findings of preliminary analyses conducted on a group of 80 women aged 40-65 years. The study investigates the relationship between selected acoustic parameters and body composition. Pearson's correlation coefficient (r) was employed to analyse the associations between the variables.

The study utilized Pearson's correlation coefficient to examine the relationships between formant frequencies (particularly F1) and various body composition metrics, including height, weight, fat-free mass, and water content.

The analyses revealed significant correlations between formant frequencies, especially F1, and body height, weight, fat-free mass, and water content. Contrary to some previous studies, positive correlations were also observed between body composition and parameters related to voice instability and loudness.

This study provides novel insights into vocal aging in women, emphasizing the role of body composition. This aspect has not been previously explored in relation to acoustic parameters in menopausal women, thereby contributing to the existing body of knowledge.

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ANALYSIS OF MYCOTOXINS IN BIOLOGICAL SAMPLES FROM WOMEN WITH ENDOCRINE DISORDERS

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Hormones play a key role in a woman's life, affecting various stages of her development from puberty, pregnancy and breastfeeding to menopause [1]. Contact with environmental chemicals with endocrine activity, termed xenoestrogens, can lead to endocrine and reproductive system disorders [2]. These compounds affect the endocrine system by mimicking the action of oestrogen, resulting in hormonal imbalance. The most common sources include pesticides, food packaging, bottles, toys, and food or feed contaminated with moulds that produce secondary metabolites (mycotoxins) [3].

Mycotoxins such as ochratoxin A (OTA) and zearalenone (ZEN) pose a significant health risk due to their widespread occurrence in food. Both compounds have endocrine disrupting effects, which can lead to serious health consequences, especially in women [1]. OTA has toxic effects on the kidneys and immune system, and new research also points to its effects on the endocrine system - through thyroid dysfunction and estrogen-like properties. ZEN, being a potent mycoestrogen, binds to oestrogen receptors, which can lead to menstrual disorders, fertility problems and increased risk of hormone-dependent cancers [4-5].

A total of 123 samples were collected from women diagnosed with endocrine disorders. Among others, 41 blood samples, 41 urine samples and 41 placenta samples were analysed. OTA concentration was determined by HPLC with fluorescence detection and OchraPrep immunoaffinity columns, while ZEN was analysed by HPLC-MS/MS technique using BondElut columns.

ZEN was detected in 24 of the 41 samples tested to date, with the highest concentration recorded being 0.072 ppb. ZEN metabolites were also included in the analysis, as the compound undergoes biotransformation in intestinal cells to alpha and beta forms. Additionally, ZEA can exist as a trans and cis isomer - of which the cis form has a higher affinity for oestrogen receptors, highlighting the importance of identifying these metabolites.

OTA was detected in all 41 samples tested, reaching a maximum concentration of 0.27 ppb.

Preliminary results confirm the presence of mycotoxins in biological samples, supporting the hypothesis of a link between exposure to hormonally active mycotoxins and the occurrence of endocrine disruption in women.

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SUSCEPTIBILITY TO MANOGEPIX AND ISAVUCONAZOLE OF REPRESENTATIVES OF *PICHIA CACTOPHILA* SPECIES COMPLEX

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Introduction: The most common species causing infections among *Candida* spp. remains *Candida albicans*; however, in recent decades, an increase in infections caused by non-*albicans Candida* species has been observed. Furthermore, emerging reports of infections caused by rare yeasts, such as *Pichia norvegensis* and *Pichia cactophila*, have come to light due to their inherent resistance to fluconazole and variable susceptibility to other azoles. These characteristics make the treatment of infections caused by such species particularly challenging [1]. Manogepix is a novel antifungal agent developed for the treatment of invasive fungal infections. It exhibits a unique and multidirectional mechanism of action through the inhibition of the fungal enzyme Gwt1 acetyltransferase, which plays a key role in glycosylphosphatidylinositol (GPI)-anchor biosynthesis [2].
Isavuconazole works by inhibiting the fungal enzyme lanosterol 14α-demethylase, which is essential for ergosterol synthesis, a key component of the fungal cell membrane. This disruption weakens the cell membrane, leading to fungal cell death [3].
Due to the clinical relevance and therapeutic difficulties associated with rare yeast infections, it is crucial to investigate the *in vitro* activity of new antifungal compounds against these pathogens. Therefore, the aim of this study was to expand the current understanding of the susceptibility of clinical isolates belonging to the *Pichia cactophila* complex to manogepix and .

Material: 31 clinical isolates of *Pichia cactophila* and 2 isolates *Pichia norvegensis* of were obtained from from University Clinical Hospital in Wroclaw.
Methods: (1) Identification was performed by MALDI-TOF mass spectrometry. (2) Evaluation the susceptibility of the strains to manogepix was tested with EUCAST microdilution method.

Results: MIC range of manogepix was 2 - 4 mg/L with both MIC_{50} and MIC_{90} of 4 mg/L for *Pichia cactophila* strains, while MIC values for 2 tested strains of *Pichia norvegensis* were lower – 0,5 mg/L and 2 mg/L. MIC range of isavuconazole was 0,015625 - 1 mg/L with MIC_{50} of 0,25 mg/L and MIC_{90} of 0,5 mg/L for *Pichia cactophila* strains, while MIC values for 2 tested stains of *Pichia norvegensis* were 0,25 mg/L and 1 mg/L.

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REGENERATION STRATEGY OF BLACK POPLAR (*POPULUS NIGRA* L.) ALONG THE VISTULA RIVER

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Black poplar is a characteristic species of riparian floodplain forests, which are becoming increasingly rare in Poland. Centuries of human activity and the lack of natural regeneration have led to a decline in the number of individuals of this species [1,2].

We examined four populations (a total of 623 individuals) of black poplar located along different sections of the Vistula River, which vary in their degree of transformation and environmental conditions. Each population consisted of a group of mature trees and a group of naturally regenerated trees.

The aim of the study was to compare the gene pools of mature trees with those of naturally regenerated trees and to assess species purity, clonality and genetic diversity. The analyses were based on the polymorphism of 16 nuclear DNA microsatellite loci and species-specific nuclear and chloroplast DNA markers.

We identified one hybrid individual among the group of mature trees from the lower section of the Vistula River. The results showed that clones constituted a total of 41% of all trees. The analyzed populations were characterized by a high level of genetic variation. The parameters of genetic variability were comparable between the individual groups. The genetic differentiation among the natural regeneration groups was almost twice as high as among the mature tree groups. Depending on the method, two or three genetic clusters were distinguished. The population located closest to the river's mouth differed the most from the others. We observed that full generative regeneration occurred only in the middle section of the river, which is the least transformed area. In this case, the natural regeneration group reflected the gene pool of the mature tree group. As for the other natural regeneration groups, they reflected the gene pool of mature trees to a much lesser extent.

River regulation and the transformation of floodplains have resulted in a lack of suitable habitats for natural regeneration. Moreover, black poplar populations in Poland are usually old and occur in small groups. Our results indicate the need to monitor seedlings and young trees along rivers, as well as to take action to protect the gene pool of black poplar in our country.

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COULD AROMATIC COMPOUNDS RIVAL DNA NUCLEOBASES IN PLATINUM-BASED ANTICANCER THERAPY? EVALUATING BINDING COMPETITION AND TREATMENT IMPLICATIONS

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Pt(II) drugs are among the oldest and most widely used anticancer agents. Their primary mechanism of action involves forming cross-links with nucleobases in DNA, which inhibits DNA replication and ultimately induces apoptosis in cancer cells [1]. However, during therapy with platinum-based drugs, patients often take other medications, including drugs to mitigate the side effects of chemotherapy. These include Proton Pump Inhibitors (PPIs), used to reduce gastrointestinal discomfort [2], and vitamin B6 administered alongside magnesium ions and other vitamins from the B group to alleviate peripheral neuropathy, a common side effect of platinum-based treatment [3]. Pt(II) drugs are characterized by relatively low selectivity [4]. This raises the question: could aromatic compounds with structures similar to nucleobases compete for binding sites on DNA? Preliminary analyses of theoretical, experimental, and in vitro studies on cell lines and microorganisms support the hypothesis of competitive binding [5–8]. That's why another question arises: could the presence of aromatic compounds other than nucleobases in DNA diminish the therapeutic efficacy of platinum-based drugs?

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BETWEEN CLONES AND SEXES: THE ROLE OF DIOECY AND CLONALITY IN SHAPING SPATIAL GENETIC STRUCTURE IN *POPULUS ALBA* L

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Clonality and dioecy are key traits that can significantly influence the spatial genetic structure (SGS) of populations [1, 3]. While their individual effects have been widely studied, their combined impact—particularly in long-lived woody species—remains underexplored [2]. White poplar, a dioecious and clonal tree, offers a unique opportunity to investigate how these factors influence SGS patterns in natural populations of increasingly rare riparian forests [4].

In our study, we analyzed two white poplar sites in Poland, including the Rogaliński Landscape Park in Rogalin and the Dębiński Forest in Poznań using nuclear microsatellite markers, population genetics and spatial-based methods to evaluate how clonality and sex influence SGS.

Our results suggest moderate levels of genetic diversity and high clonal dominance, with aggregated genotypes and limited intermixing among clones in both stands. At the ramet level, SGS was notably stronger, highlighting the pronounced effect of clonality. We observed sex-dependent SGS patterns, with female individuals exhibiting higher kinship coefficients and Sp statistics. This result suggests that sex-specific reproductive investment also contributes to divergent spatial genetic patterns and may even drive the spatial segregation of sexes (SSS).

These findings reinforce previous observations on single populations [1, 2] and offer new insights into the genetic and demographic processes shaping clonal, dioecious tree populations. Understanding how reproductive factors influence SGS is essential for predicting the adaptive potential of species like *Populus alba*, especially under increasing threats from habitat fragmentation and climate change [5]. Our results contribute to the wider considerations of sex-biased spatial patterns in forest trees and underscore the importance of considering both clonality and sex in conservation strategies.

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EVALUATING DNA PRESERVATION IN HUMAN SKELETAL REMAINS FROM STALAG IID: A COMPARATIVE STUDY

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In forensic genetics, obtaining a reliable genetic profile is of critical importance—particularly in contexts such as mass disasters, victim identification, and investigations involving totalitarian regimes [1-3]. In recent years, there has been a notable increase in research focused on identifying the most effective sources of DNA for STR (Short Tandem Repeat) typing from skeletal material [4-6].

In this study, we focus on obtaining genetic material from smaller anatomical structures whose use is less invasive and more conducive to preserving bone integrity. Specifically, we analyzed three small auditory bones—the malleus, incus, and stapes—and compared them to teeth, a traditional DNA source in forensic investigations.

We collected ossicle samples from 44 individuals recovered from Stalag IID and analyzed them for STR profile completeness, large and small fragment DNA concentrations, Y-chromosome concentration, and degradation index (calculated as T_Small/T_Large).

Our results demonstrate that the auditory ossicles outperformed teeth across all evaluated parameters. These findings indicate that auditory ossicles are a promising alternative source of high-quality genetic material, particularly in cases where maintaining the integrity of skeletal remains is essential or when other bones are unsuitable for analysis.

This study was approved by the Ethics Committee at the Pomeranian Medical University in Szczecin (Permision number KB.006.030.2025).

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BIOCOMPATIBILITY OF POLYMERIC MEMBRANES FOR WOUND DRESSING - *IN VITRO* STUDY

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Chronic wounds such as venous ulcers, pressure injuries, and diabetic wounds pose a significant challenge for healthcare systems across Europe. It is estimated that in Poland up to one million individuals are affected by this issue. Chronic wounds often lead to prolonged treatment, complications, generate substantial healthcare costs and significantly impact patients' quality of life. In response to the increasing demand for innovative wound dressing, biodegradable polymers with high biocompatibility have gained growing scientific interest [1].

The aims of this study were to optimize sterilization methods of electrospun membranes made out of pure Polycaprolactone (PLC) and Polycaprolactone /Polyethylene glycol (PLC/PEG) blend and evaluate the *in vitro* biocompatibility of them in relation to immortalized human skin fibroblasts (MSU-1.1 cell line).

Two sterilization methods of membranes were tested: 2-hour UV exposure or UV exposure combined with 20-minute incubation in 70% ethanol. Then they were subjected to series of PBS washes under different conditions: 37°C versus room temperature (static versus dynamic). Biocompatibility was assessed according to ISO 10993-5:2009 which describes test methods to assess the *in vitro* cytotoxicity of medical devices. Experiments were carried out on fibroblasts culture directly on 5 mm diameter membrane disks or cells cultured in the presence of extracts obtained following 24-hour incubation of the membrane in the cell culture medium. Biocompatibility was assessed by measurement of cell metabolic activity (MTT assay) and by determine of cell adhesion on the membrane by fluorescence staining to visualize cell nuclei (DAPI) following 24, 48 and 72 hours.

The results revealed that the examined membranes exhibits cytotoxic properties and requires post-processing after the sterilization procedure. To abolish cytotoxic effect, promote cell adhesion and proliferation, the membranes subjected to the proposed sterilization methods require at least six washes in PBS. Beneficial effects on cell proliferation was confirmed by MTT assay before and after serial PBS washes (0,325 vs 0,533, respectively). This was also confirmed by DAPI staining (cells were not visible on the unwashed membrane surface). Moreover, the assessment of biocompatibility using extracts proved to be more reliable than direct cell culture on the biomaterial due to the possibility of cell adhesion to the biomaterials surface.

The study shows that considering the medical applicability of the developed polymers, it is necessary to develop a method of reducing their potential cytotoxicity and increasing biocompatibility after a dedicated sterilization method.

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SECTION OF BIOLOGICAL AND MEDICAL SCIENCES
POSTER PRESENTATIONS

THE ROLE OF THE HMU SYSTEM IN PIGMENT FORMATION IN *PORPHYROMONAS GINGIVALIS*

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Porphyromonas gingivalis is one of the main bacterial agents involved in the development and progression of chronic periodontitis in humans. As a heme auxotroph, *P. gingivalis* cannot synthesize heme nor utilize siderophores for iron acquisition. Therefore, it relies on human hemoproteins as sources of both heme and iron [1]. Heme uptake by *P. gingivalis* is primarily mediated by the Hmu system, composed of HmuYRSTUV proteins, with HmuY (a hemophore-like protein) and HmuR (an outer membrane TonB-dependent heme receptor) being the main players in this process. HmuS, a reverse ferrochelatase, removes iron from heme, allowing iron acquisition. The Hmu system cooperates with gingipains – two arginine-specific (RgpA and RgpB) and one lysine-specific (Kgp) cysteine proteases. Gingipains degrade human hemoproteins, such as hemoglobin, albumin, and hemopexin, releasing heme, which is then transported into the bacterium by the Hmu system. However, excess heme can be toxic due to its ability to catalyze the production of reactive oxygen species. Therefore, *P. gingivalis* deposits heme on its cell surface, forming a pigment composed mostly of the μ-oxo bisheme, which serves both as a heme reservoir and a protective buffer against oxidative stress. Importantly, gingipains, mainly Kgp, are involved in pigment formation [1-3].

Disruption of heme uptake by the inactivation of the Hmu system influences *P. gingivalis* iron and heme homeostasis [4]. Therefore, this study aimed to determine the involvement of the Hmu system in pigment production, particularly the HmuS protein, as it plays a role in heme metabolism. We constructed the *P. gingivalis hmuS* gene deletion mutant strain (Δ*hmuS*) and determined the pigment composition using spectroscopy and LC-TOF-MS in ESI positive mode. We observed that the wild-type strain exhibits red fluorescence under UV light, attributed to surface-bound porphyrins, whereas the Δ*hmuS* mutant strain shows green fluorescence, suggesting changes in pigment composition. Moreover, our findings demonstrated that deletion of the *hmuS* gene results in the reduction of non-iron porphyrins in the pigment fraction compared to the wild-type strain. These results indicate that the HmuS protein is essential not only for iron acquisition by *P. gingivalis* but also may play a role in maintaining proper pigment composition.

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DISCOVERY OF THE FIRST AK4 INHIBITORS USING HIGH-THROUGHPUT SCREENING OF A STRUCTURALLY DIVERSE COMPOUND LIBRARY

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Human mitochondrial adenylate kinase 4 (AK4) is an ATP:AMP phosphotransferase belonging to the nucleoside monophosphate kinase family, key enzymes involved in maintaining nucleotide homeostasis and cellular metabolism. Over the past decade, human AK4 has emerged as a novel diagnostic and prognostic marker, as well as a potential therapeutic target in various cancers, particularly lung cancer. To date, no AK4 inhibitors have been reported in the scientific literature, which significantly hinders the rational design and development of AK4-targeted therapeutics. Furthermore, there is a lack of convenient and robust methodologies suitable for the high-throughput screening (HTS) of large compound libraries against this target, posing a major analytical challenge. Conventional techniques, such as high-performance liquid chromatography (HPLC), although direct and sensitive, are labor-intensive, time-consuming, and costly, limiting their applicability in high-throughput settings. To fill this gap, we developed the first luminescence-based high-throughput screening protocol for AK4 inhibitor discovery. The assay optimization included the determination of the optimal reaction mixture composition, incubation time, temperature, and protein concentration required for reliable signal detection. The HTS assay was used to screen a library of compounds with unique molecular scaffolds, leading to the identification of the first inhibitor candidates (hits). The identified hits were further validated using HPLC as an orthogonal method to confirm AK4 inhibition. As a result, two compounds with significant AK4 inhibitory potential were discovered and characterized by their anticancer activity against lung cancer cell lines. These compounds represent promising molecular scaffolds for further chemical modification to obtain derivatives with enhanced AK4 inhibitory potential.

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MATERIALS BASED ON POLYSACCHARIDES ENRICHED WITH PLANT EXTRACT AS POTENTIAL WOUND DRESSINGS

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Polysaccharides are widely used in various industrial sectors, including developing biopolymeric sponges with potential medical applications. They are emerging as a promising alternative to traditional dressings [1]. This study investigates using a mixture of pullulan and chitosan to create sponges enriched with an extract from *Dipsacus sylvestris*, which could serve as novel dressings materials. The obtaining structures exhibit good physicochemical (such as mechanical properties) and biological properties. The anti-inflammatory properties of the *Dipsacus sylvestris* extract further enhance the potential of these materials to support wound healing and protect the skin from infections [2-4].

The dressings materials underwent a series of tests, including ATR-FTIR spectroscopy, scanning electron microscopy (SEM), mechanical strength testing, and evaluation of antioxidant, antibacterial, and swelling properties [5]. The results demonstrate that the materials possess adequate mechanical strength and significant antioxidant and antioxidant activity. Additionally, these materials exhibit swelling properties, which are crucial for practical dressing functionally.

These findings suggest that the developed biopolymeric materials, could provide an effective alternative to traditional dressings, offering potential benefits in wound care and infection treatment.

Fig. 1. Extraction Dipsacus sylvestris; Received wound dressings; Dipsacus sylvestris [4].

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EVALUATION OF THE PROPERTIES OF DERMOCOSMETICS WITH POTENTIAL USE FOR SKIN CARE OF PATIENTS TREATED WITH RADIATION THERAPY OF THE HEAD AND NECK CANCERS

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Radiotherapy as a monotherapy or in combination with chemotherapy is still one of the standard methods of treating head and neck cancers. However, ionizing radiation affects both cancer cells and healthy tissues. As a consequence, this results in radiation reactions in tissues, including the skin [1].

The aim of the study was to assess the preclinical properties of dermocosmetics with potential use in skin cleansing and care of patients treated with radiotherapy due to head and neck cancer to prevent and alleviate early post-radiation reactions.

The assessment of the irritation effect after repeated administration was performed on a rabbit model based on the cumulative index of erythema and edema according to the ISO point scale. Male New Zealanders, were treated for 14 consecutive days with 0.5 g of ONKO emulsion, 0.5 g of S.O.S ONKO emulsion, 0.5 g of washing gel, and 0.5 g of washing lotion, separately. The study of sensitization properties was performed on albino guinea pigs. The 0.5 g of ONKO emulsion, 0.5 g of S.O.S ONKO emulsion, 0.5 g of washing gel, and 0.5 g of washing lotion were applied separately on the skin of males for 3 consecutive days for 3 weeks. The intensity of allergic changes was expressed on a point scale according to ISO. A microbiological test of maintenance was also performed using the Pharmacopoeial method (plate method). The following strains were marked: *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Candida albicans,* and *Aspergillus brasiliensis*.

The *in vivo* assessment of the irritating effect on rabbits and the sensitizing effect on guinea pigs based on the ISO scale showed no or weak irritating effect of all tested dermocosmetics and a complete lack of sensitizing effect. The highest irritation index (the value of 1.76) was observed for ONKO emulsion, the rest of the tested products were rated 0 points. In the case of the sensitizing effect, animals treated with all medical devices received 0 points on the ISO scale, corresponding to the lack of visible changes.

The assessment of the functional properties of the products with the maintenance test showed that all of them met criterion A of the degree of reduction of the test microorganisms.

The lack of irritating and sensitizing effects and good preservative properties of the developed dermocosmetics became the basis for further development of the products in a research experiment with the indication of post-radiation skin reactions among oncological patients after radiotherapy of head and neck cancers [2].

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CHITOSAN COMPOSITES CROSSLINKED WITH HEMOGLOBIN AND BOVINE SERUM ALBUMIN WITH THE ADDITION OF BODIPY AS POTENTIAL MATERIALS FOR APPLICATION IN PDT

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Photodynamic therapy (PDT) is a clinically approved method of treating cancer based on the selective destruction of lesional cells and tissues by reactive oxygen species. Three components are responsible for the therapeutic efficacy of PDT: a photosensitizer (PS), a light source with the specific wavelength, and molecular oxygen present in the tumor environment. Nevertheless, most photosensitizer compounds are hydrophobic, which results in their aggregation in biological fluids, thus reducing the effectiveness of treatment. The insufficient selectivity of PS against cancer cells is also an additional limitation [1]. These drawbacks can be eliminated by using suitable carriers for photosensitizers. One such solution could be chitosan-based carriers that improve the dissolution rate of poorly soluble drugs and provide their targeted delivery [2].

The presented research describes the preparation and characterization of protein-crosslinked chitosan composites with a 5% addition of BODIPY dyes designed for application in PDT. The spectroscopic properties of the obtained materials were characterized by infrared spectroscopy (ATR-FTIR), UV-Vis absorption spectroscopy, and spectrofluorimetry. The surface morphology of the samples was examined by SEM and AFM. The thermal stability and mechanical properties of the obtained materials were also checked. In addition, the swelling ability and biodegradability of protein-crosslinked chitosan films were investigated. In the final step, the adsorption of human serum albumin (HSA) on the obtained materials and the profile of dyes released from chitosan composites were also determined.

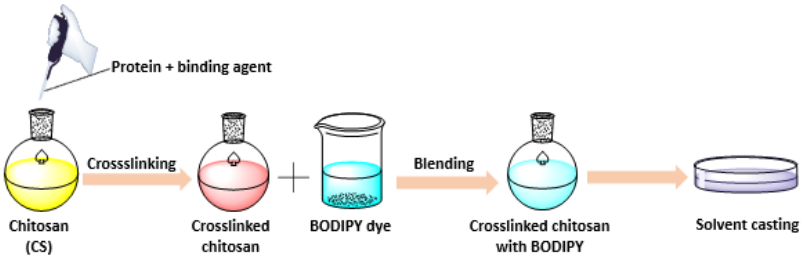

Fig. 4. Preparation of protein-crosslinked chitosan films with BODIPY.

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2D AND 3D TUMOR MODELS: APPLICATION TO DETERMINE THE PHOTODYNAMIC ACTIVITY OF THE ORIGINAL PHTHALOCYANINES

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Since cancer is a worldwide problem and its incidence is still increasing, we decided to utilize 3D tumor models to further expand our portfolio of experimental models to test our original PS. 3D models should be closer to an actual *in vivo* environment than a typical 2D cellular model (monolayer of cells). Even though the 2D models are simple to use and very affordable, frequently used as an initial screening tool for new potential drugs, they cannot mimic the complex interactions between cancer cells and the surrounding microenvironment in the human body [1]. Different gene and protein expression or drug response has been shown to be different from that of cell cultures and *in vivo*. The use of 3D models, e.g. spheroids, that partially mimic the physiological microenvironment may be a feasible solution. 3D multicellular tumor models can elucidate more complex mechanisms and are proving to be a promising tool for drug development. But there is still a lack of vasculature or presence of a complex tumor microenvironment and microarchitecture [2,3]. Based on the abovementioned aspects, we decided to utilize 2D and 3D cellular heterotypic models in our research in the field of photodynamic therapy of cancer. Original amphiphilic and hydrophilic (aza)phthalocyanines (cationic and anionic) were chosen as photosensitizers. Photodynamic activity was determined on malignant cell lines expressing tGFP proteins (tGFP-HeLa – human cervical carcinoma, tGFP-CT-26 – mouse colon carcinoma), and on non-malignant cell lines RFP-HUVEC (human umbilical vein endothelial cells expressing RFP) and MRC-5 (human lung fibroblasts); and their combinations (1:1 ratio). Toxicity of cytostatic drugs (24 h, 48 h; cisplatine, paclitaxel, 5-FU, irinotecan) were tested on the same cell lines and their combinations. Multicellular spheroid models derived from tGFP-HeLa and tGFP-CT-26 cell lines were generated using on ultra-low adhesion plates and same PSs and cytostatic drugs were also tested using this model. The amphiphilic cationic PS demonstrated the highest phototoxicity against all cell lines. 3D spheroid cell models displayed higher resistance to the treatment expressed as higher concentrations needed to achieve IC_{50}. However, further research is needed especially the development of 3D heterotypic models for PDT and cytostatic toxicity testing in our group, determine the distribution of PSs within the spheroids or to determine the spatial arrangement of individual cell populations within a heterotypic spheroid.

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EVALUATION OF THE EFFECT OF VANILLIC ACID ON THE FUNCTIONS OF HUMAN IMMUNE CELLS AND ITS PROTECTIVE PROPERTIES TOWARDS HUMAN PLASMA COMPONENTS

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Phenolic acids, aromatic carboxylic acids substituted with hydroxyl groups, are one of the main sub-groups of polyphenols found in plants [1]. Vanillic acid (VA) is a phenolic acid with a pleasant odor, used as a flavoring agent. It is found in various dietary sources, such as dried fruits, sweet basil, and pumpkin seeds, as well as medicinal plants, like the roots of *Angelica sinensis*. Its antidiabetic, antibacterial, antioxidant, and anti-inflammatory activities, among others, have been documented [2]. However, its effect on human immune cells has not yet been investigated. Therefore, the present study aimed to evaluate the antioxidant and anti-inflammatory impact of VA on human neutrophils and plasma *ex vivo*.

First, the impact of VA on reactive oxygen species (ROS) levels during oxidative burst in neutrophils was tested. Then, the anti-inflammatory potential was assessed, as manifested by VA's influence on the secretion of IL-8, TNF-α, and elastase by neutrophils. Additionally, the protective effects of VA on human plasma under oxidative stress were assessed. The ability of VA to reduce oxidative stress and carbonylation was also tested in cell-free *in vitro* models, i.e., $NO^{\bullet}$, HOCl, $O_2^{\bullet-}$ H_2O_2 and $HO^{\bullet}$ scavenging assays and test of effect on advanced glycation end products formation. Spectrophotometric, immunoenzymatic, fluorimetric, and chemiluminescence methods were used. Furthermore, the viability of neutrophils and peripheral blood mononuclear cells in the presence of VA was evaluated by flow cytometry. Its activity was compared to reference compounds – Trolox, dexamethasone, quercetin, and aminoguanidine.

The analyses showed that VA significantly limits ROS levels in neutrophils, most likely due to indirect mechanisms rather than direct scavenging, as non-cellular assays suggest. It also sufficiently protected plasma elements from oxidative damage, and prevented non-enzymatic protein glycation. Moreover, it noticeably ameliorated the pro-inflammatory function of neutrophils. VA turned out to be biocompatible with neutrophils and peripheral blood mononuclear cells. The obtained results call for further research, including investigation of VA's effect on other human cells, in order to explore other possible mechanisms of action.

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PHOSPHORUS NUTRITION AS A REGULATOR OF OAT VARIETES (*AVENA SATIVA*) GROWTH AND PHOTOSYNTHETIC APPARATUS ACTIVITY

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Oat (*Avena sativa*) is a highly nutritious and versatile cereal crop originally cultivated mainly for livestock feed [1]. However, due to its exceptional edibility, rich nutritional profile, and pharmacological potential, it has gained increasing recognition as a valuable food source. Growing consumer awareness of their health benefits and the rising demand for healthier food choices have led to a significant expansion in oat cultivation and consumption [2]. Oats can adapt to various climatic conditions, allowing them to be cultivated in diverse regions worldwide. According to the Central Statistical Office, the oat cultivation area in Poland in 2024 was 500 thousand hectares [3]. Phosphorus (P) is essential for adequately growing oats and all plants. P is a component of organic compounds necessary for metabolic processes, including photosynthesis, and can influence gene expression and enzyme activation [4]. The conducted analyses aimed to investigate the impact of differentiated phosphorus nutrition on oats' growth and photosynthetic activity. The studies were carried out on four oat varieties (Gepard, Rambo, Wulkan, Komfort) cultivated on liquid media for 3 weeks. Three types of media were used: inorganic phosphorus in the form of KH_2PO_4 (+P), organic P - phytic acid (F), and phosphorus-free medium (-P). Analyses of the growth parameters of plant shoots and roots and inorganic P content were conducted. In the shoots of the oat varieties, the NBI index and the levels of chlorophylls, carotenoids, flavonoids and chlorophyll *a* fluorescence were determined. The studies showed that P deficiency negatively affects the oat varieties growth and photosynthetic activity. However, phytate is a good source of P for all studied oat varieties.

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EFFECT ON MOULDS GROWTH AND MYCOTOXIN PRODUCTION BY PLANT EXTRACTS

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Every day we are exposed to negative factors that affect our health and life. One such factor is mold, to which the human body is exposed through the air, skin and also the food we eat. Mycotoxins, which are secondary metabolites of fungi, show the ability to penetrate body fluids and tissues, often causing serious health problems. The presence of mycotoxins in food and feed adversely affects human and animal health. Mycotoxigenic fungi pose a threat in food production from field to storage to processing.

Contact with mycotoxigenic fungi due to their ubiquity is unavoidable, so the goal of science should be to inhibit their negative effects. In an era of spreading diseases of civilization, often related to lifestyle and quality of life, we are seeing an increase in public awareness and emphasis on preventive health care [1].

Plant extracts contain a variety of bioactive components that can control mold growth. Metabolites produced by plants offer hope for the future. They are characterized by an abundance of phytochemicals with antioxidant and antimicrobial activities. Plant extracts are obtained by the extractive action of a suitable solvent, on a plant or part of a plant, most often dry and ground. Bioactive plant compounds can be extracted from various parts of plants, such as leaves, flowers, fruits, stems and roots. These compounds can damage cellular structures and disrupt metabolic processes, which affects the growth and development of fungal pathogens and inhibits infection. Inhibition of fungal development is often connected to the reduction of mycotoxin production, which is highly desirable effect and helps lower risks associated with the presence of this toxic secondary fungal metabolites [2].

The effect of extracts depends largely on the plant species, the preparation of plant extracts and the sensitivity of the fungi tested. Plant bioactive compounds are considered one of the most promising alternatives to antibiotics and fungicides because they are widely regarded as environmentally friendly. Consumers are increasingly choosing organic foods and natural inhibitors because they are biodegradable and considered safer for health and nature. The use of plant-derived products (plant extracts and essential oils of plants) has shown promising results in reducing mycotoxigenic fungi and mycotoxins in food [2,3].

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ECHOES OF ANCESTRY: HISTORICAL HYBRIDIZATION AND INTROGRESSION IN EURASIAN WILD BOAR (*SUS SCROFA* L., 1758) POPULATIONS

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Hybridization, defined as the interbreeding of distinct species or populations, and introgression, the incorporation of foreign alleles into the gene pool through repeated backcrossing, are fundamental mechanisms influencing the genetic structure of many wild species [2]. Historical hybridization events between the Eurasian wild boar (*Sus scrofa*) and the domestic pig (*Sus scrofa domesticus*) have left measurable imprints on the genetic architecture of contemporary populations [1,3,4]. This study aimed to evaluate the extent and impact of these historical gene flow events in a selected wild boar population in Poland.

Using 37 microsatellite markers and advanced genetic analysis tools (GenAIEx, STRUCTURE), we identified significant signatures of introgression, particularly in individuals exhibiting atypical phenotypes. The STRUCTURE analysis revealed distinct genetic clusters, with hybrids displaying allelic patterns indicative of both wild boar and domestic pig ancestry. These findings confirm the persistence of domestic alleles within wild populations, suggesting a long-term influence of hybridization events, potentially linked to domestication escapees and human-mediated introductions.

Our results emphasize the need for conservation strategies that preserve the genetic integrity of wild boar populations while considering the historical context of gene flow with domesticated relatives. Further research is necessary to elucidate the evolutionary and ecological implications of this introgression, providing a foundation for effective wildlife management and genetic conservation efforts.

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OPTIMISATION OF EXTRACTION AND PHYTOCHEMICAL PROFILING OF THE DRY EXTRACT OF *PRUNUS PADUS* L. BARK

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Prunus padus L. (bird cherry) is a deciduous small tree widespread in Europe and northern Asia with acknowledged application in traditional medicine of its bark, leaves, and flowers. The literature analysis proved that bark is used to treat skin infections, wounds, arthritis, gastrointestinal tract diseases, or sore throats. Previous studies on bird cherry bark are scarce. However, the available data suggest the presence of a rich polyphenol fraction, especially flavones, flavonols, procyanidins, and phenolic acids, which might contribute to the therapeutic potential of the plant material due to their anti-inflammatory, antioxidant, and antimicrobial properties [1,2]. However, a deeper investigation of the chemical composition, extraction effectiveness, and molecular mechanism of action of thoroughly phytochemically characterized extracts is still required to validate the plant material for pharmaceutical application.

Therefore, the main purpose of this study was to optimize the extraction procedure and phytochemical profiling of the extract from *P. padus* bark. In the first stage of the project leading to obtaining the polyphenol- and proanthocyanidin-rich extracts, various extraction solvents (water, ethanol, ethanol-water), extraction methods (reflux, ultrasonic-assisted, maceration), and extraction conditions (including temperature, time, ultrasound frequency) were tested. Extracts were subjected to qualitative and quantitative chemical characteristics using analytical methods, including UHPLC-PDA-ESI-MS^3 for structural studies and spectrophotometric assays for measurements of total polyphenolic content (TPC, Folin-Ciocalteu method) and total content of proanthocyanidins (TTC, vanillin, and butanol/hydrochloric assays). A semi-biological, spectrophotometric superoxide anion scavenging test was used to evaluate the extraction optimization process.

In total, more than 20 extracts were prepared. The extraction optimization process revealed significant differences in TPC (141,6 – 282,9 mg/g GAE [gallic acid equivalent]) and TTC (28,5 – 107,3 mg/g PB2 [procyanidin B2 equivalent]), depending on the method used. The HPLC-PDA standardized by LC-MS^3 analysis of the bark extract resulted in full or partial identification of phenolic constituents. On the one hand, the antioxidant activity analysis showed that individual extracts differ significantly in SC_{50} values (scavenging concentration). On the other hand, all tested extracts had SC_{50} values up to ~15 times lower than Trolox (vitamin E analog, strong antioxidant), which was a positive control. The obtained results constitute the basis for selecting the appropriate extract for further chemical and biological research verifying the therapeutic effectiveness of *P. padus* bark in the context of traditional indications.

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CATIONIC SURFACTANTS IN THE FIGHT AGAINST MICROBIAL RESISTANCE

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Microbial resistance to commonly used antimicrobial compounds is becoming an increasing problem around the world. Quaternary ammonium salts (QAS), which are cationic surfactants, have a characteristic amphiphilic structure (hydrophilic polar part and hydrophobic, non-polar hydrocarbon chain). Due to their characteristic properties, these compounds are widely used in medicine and industry as disinfectants, gene and drug carriers, fungicides, biocides and detergents [1,2].

Due to the increasing resistance of microorganisms to these compounds, it is necessary to search for new QAS structures that are effective against resistant forms of pathogens. For this reason, quaternary ammonium salts with different structures were designed and synthesized, and then their biological activity against Gram positive bacteria - *Staphylococcus epidermidis* ATCC 35984 and Gram negative bacteria - *Pseudomonas aeruginosa* PAO1 was determined. The minimum inhibitory and bactericidal concentrations of the tested QAS were investigated. The compounds were characterized by an antibacterial activity against Gram-positive bacteria. The influence of the tested surfactants on the eradication of biofilm and the adhesion of microorganisms was also examined. These studies, showed a stronger effect of the gemini surfactant. In order to determine whether the tested QAS can be safely used in medicine, their effect on hemolysis of sheep erythrocytes was also determined. It has been shown that at low concentrations these compounds do not cause hemolysis.

The conducted research indicated the influence of the structure of quaternary ammonium salts on their antibacterial properties.

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THE INFLUENCE OF Dr FIMBRIAE ON THE ADHESION OF *ESCHERICHIA COLI*/Dr+ STRAINS TO ABIOTIC SURFACES AND KIDNEY STONE COMPONENTS AT VARIABLE pH

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Urinary tract infections (UTIs) are one of the common bacterial infections, affecting millions of people worldwide each year. Uropathogenic *E. coli* strains are the main causative factor of UTIs [1]. These bacteria contain multiple virulence factors responsible for the initial step of adhesion and colonization of the urinary tract. One of the most prevalent among UPEC are Dr fimbriae which were the subject of the studies performed [2]. The aim of the research was to determine the role of Dr fimbriae in promoting the adhesion of laboratory *E. coli*/Dr^+ strain to abiotic surfaces, including glass, polystyrene and kidney stone components, under variable pH conditions, in relation to the *E. coli*/Dr^- strain not producing Dr fimbriae. Adhesion assays were conducted on polystyrene, glass, calcium oxalate monohydrate, and hydroxyapatite at pH values of 5.7, 7.0, and 8.0, with variable shear stress applied to the surfaces of the first two materials.

E. coli/Dr^+ strain showed significantly enhanced adhesion to polystyrene and glass at pH 5.7 and maintained strong attachment despite increasing shear stress. Adhesion gradually decreased with rising pH. On hydroxyapatite, Dr^+ bacteria exhibited high pH-dependent binding, strongest at pH 5.7 and minimal at pH 8.0. In contrast, adhesion to calcium oxalate monohydrate remained consistently high across all pH conditions. In contrast, *E. coli*/$Dr^–$ strain showed significantly lower adhesion under the above conditions.

These results demonstrate that Dr fimbriae significantly enhances the adhesion of *E. coli* to both abiotic and pathological surfaces, with environmental pH being a key modulator of binding strength. This highlights the role of these bacterial adhesins in the pathogenesis of UTI and the adaptive functions of uropathogens to the changing environmental conditions within the urinary tract.

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NEUROPROTECTIVE PROPERTIES OF CAFFEINE AND NARINGIN IN A SH-SY5Y LINEAGE-BASED MODEL OF PARKINSON'S DISEASE

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Parkinson's disease is characterized by progressive neuronal loss, leading to a deficit of dopamine, a neurotransmitter responsible for regulating movement and other brain functions. The fundamental mechanism underlying the degeneration of dopaminergic neurons in the substantia nigra, a brain structure crucial for motor control, is neurotoxicity. At the molecular level, this process is driven by the aggregation of the intrinsically disordered protein α-synuclein (α-syn), excessive production of reactive oxygen species (ROS), and oxidative stress, leading to widespread cellular dysfunction, including mitochondrial damage. Mitochondrial impairment disrupts cellular respiration and ATP production, reducing the energy necessary for proper neuronal function [1, 3]. Evidence suggests that dietary modifications can support classical therapies, potentially allowing for a reduction in drug doses, with various dietary supplements shown to mitigate disease progression. Literature indicates that caffeine-assisted therapy may offer benefits, particularly in improving motor function through antagonism of adenosine A2A receptors. Moreover, emerging data suggest that caffeine promotes autophagy [2]. Additionally, naringin has been cited for its neuroprotective potential due to its antioxidant and anti-inflammatory properties. It engages mTORC1 and Nrf-2 pathways to combat ROS, thereby protecting mitochondria and maintaining neuronal redox balance, which counteracts degenerative processes [4].

To conduct the study, a Parkinson's disease model was developed using the SH-SY5Y cell line, with neurodegenerative changes induced by 6-OHDA. Subsequently, the EC50 dose of 6-OHDA was determined and used to assess the neuroprotective properties of naringin and caffeine in two-dimensional and three-dimensional cytotoxicity assays. The results demonstrated that both compounds exhibit neuroprotective properties against the applied neurotoxin. They maintained high cell viability in the MTT assay compared to the neurotoxin-treated control, suggesting strong antioxidant properties and mitochondrial protection, which are crucial for maintaining proper neuronal function.

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MITOFUSIN 2-DEPENDENT MITOCHONDRIAL FUSION AND ENHANCED GLUTAMINE METABOLISM DRIVE GLIOMA CELLS ADAPTATION TO DOXORUBICIN-INDUCED STRESS

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Mitofusin 2 (MFN2)–driven mitochondrial fusion and glutamine catabolism are now recognized as pivotal modulators of cellular stress tolerance [1-2]. However, their coordinated role in glioma cells chemoresistance has not been fully elucidated yet.

To address this gap, we evaluated whether enhanced MFN2-dependent fusion and elevated glutamine metabolism support the survival of T98G glioma cells under doxorubicin(DOX)-induced chemotherapeutic stress. Our *in vitro* experimental model based on 48h pulse DOX (1 μM) treatment, followed by incubation in standard culture medium for up to 14 days after exposure to the drug. Subsequently, level of specific enzymes and intracellular concentrations of glutamine and glutamate were quantified via LC-MS/MS approach, while transmission electron microscopy (TEM) and confocal microscopy revealed changes in mitochondrial architecture and their fusion dynamics. To elucidate the functional significance, glutaminase activity was suppressed using BPTES and MFN2 expression was silenced by esiRNA transfection, followed by pulse DOX treatment and subsequent estimation of changes within cell viability.

In our model, cells subjected to doxorubicin stress showed significant up-regulation of glutaminase, asparagine synthetase, and glutamate dehydrogenase, along with increase of intracellular glutamine/glutamate levels. These metabolic shifts coincided with increased MFN2 expression and extensive mitochondrial fusion. Moreover, inhibition of glutaminase and knockdown of MFN2 significantly reduced cell viability under chemotherapeutic stress, demonstrating their essential roles in adaptive resilience.

Collectively, our findings indicate that MFN2-mediated mitochondrial networking cooperates with upregulated glutamine metabolism to facilitate glioma cell survival during doxorubicin exposure. These results expose a critical bioenergetic dependency that could be exploited to amplify doxorubicin efficacy against glioma.

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ANALYSIS OF MYCOTOXINS AND CORTISOL LEVELS IN TISSUES OF WILD BOARS

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There are over 400 mycotoxins discovered so far. Of them, most commonly occurring in Poland are deoxynivalenol (DON), zearalenone (ZEN), ochratoxin A (OTA), T-2 and HT-2 toxins. Unlike other mycotoxins, zearalenone and its metabolites, namely α-zearalenol (α-ZOL), β-zearalenol (β-ZOL), α-zearalanol (α-ZAL) and β-zearalanol (β-ZAL) acts as xenoestrogens, additionally exhibiting different affinity towards estrogen receptors. Its main toxic effects are reproductive disorders in both males and females [1]. DON, also called vomitoxin can cause feed refusal, diahrea, digestive, reproductive and endocrine problems. Toxic effects of T-2 and HT-2 toxins includes loss of appetite, vomiting, weight loss, ulcers, stomach necrosis, bloody diarrhea, and dermatitis. OTA exhibit hepatotoxic, nephrotoxic, neurotoxic, immunotoxic, mutagenic and teratogenic properties.

Cortisol is one of the main hormones released during stress response. It is synthesised in the adrenal cortex from cholesterol. Unlike other stress hormones (adrenaline or noradrenaline), its release is delayed in relation to stress occurrence and reaches peak about 20 min after stressor occurrence. Cortisol's main role is to promote and maintain a high level of glucose by promoting gluconeogenesis [2].

In this project, 30 samples of body fluids (blood and bile) tissue (liver, kidney and diaphragm) were analysed regarding mycotoxins and cortisol concentration levels. Samples were collected from wild boars (male and female) harvested during seasonal hunts in years 2023-2025 from Kuyavian-Pomeranian, Greater Poland and Pomeranian Voivodeships. Aim of this study was not only to monitor mycotoxin levels in tissues of wild animals and cortisol levels caused by stress during hunt, but also to determine a possible correlation between the two. Ground for such suspicions comes from structural similarity of ZEN to estrogen, as well as known correlation between cortisol and natural estrogen [3].

Mycotoxins were analysed using HPLC-MS/MS method. In short, samples were extracted with acetonitrile:water mixture, with the addition of internal standards and glucuronidase. Immunoaffinity columns (DZT-MS Prep for trichothecenes, ZEN and its metabolites; Ochraprep for OTA) were used for clean-up stage.

Cortisol level was determined using electrochemiluminescence method. In short, samples were incubated with biotinylated antibodies. Next, streptavidin-coated particles were added, binding them to cortisol-antibody complex. Finally, current from electrode induced photon emission, which was measured by photomultiplier.

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BIOCOMPATIBLE CHITOSAN/KEFIRAN-BASED WOUND DRESSINGS CROSSLINKED WITH DIALDEHYDE KEFIRAN AND ENRICHED WITH HENOLA EXTRACTS

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The rising prevalence of patients with chronic wounds has significantly stimulated research into the development of natural wound dressings characterized by enhanced properties. In the present study, we successfully fabricated polysaccharide-based materials utilizing chitosan and kefiran, strategically incorporating hemp extract to augment their biological efficacy. The materials were characterized through a range of advanced techniques, including FTIR-ATR, AFM, SEM, and thermal analysis. These analyses provided comprehensive insights into the structural and thermal properties of the films, confirming their integrity and stability. Additionally, evaluations of mechanical properties, swelling rate, and water vapor permeability underscored their suitability for application as wound dressings.

Biocompatibility assessments were conducted via in vitro experiments utilizing MRC-5 fibroblasts and erythrocytes, demonstrating that the films possess non-toxic and non-hemolytic characteristics. Notably, the materials exhibited significant antimicrobial activity against critical pathogens such as Pseudomonas aeruginosa, Staphylococcus aureus, and Candida albicans, commonly associated with wound infections. Furthermore, the films displayed antioxidant and anti-inflammatory properties and the ability to bind serum proteins—factors essential for promoting effective wound healing.

These findings indicate that the developed polysaccharide-based materials infused with hemp extract possess considerable potential as antimicrobial and non-toxic wound dressings for practical clinical applications.

This work was supported by the National Science Centre Poland grant UMO-2022/47/D/NZ7/01821.

DESIGN AND FABRICATION OF BIOCOMPOSITE SPONGES BASED ON GELLAN GUM/MUSA SAPIENTUM/CUCURBITA MAXIMA FOR SUSTAINABLE WOUND DRESSINGS

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The development of wound dressings from sustainable resources is gaining significant interest for advanced wound care. However, creating materials that simultaneously guide important treatments and maintain sustainability presents an ongoing challenge. The study design and fabricate the biocomposite sponges that used Gellan gum (GG) and were cross-linked with Musa sapientum (MS) and the addition of varying amounts (1%, 10% and 20%) of Cucurbita maxima (P, pumpkin) pulp was especially incorporate as bioactive material (marked GG-MS@P_1, GG-MS@P_2, GG-MS@P_3). Sponge samples with pumpkin pulp extract had strong bioactivity properties. The results showed that the GG-MS@P3 formulation offered superior antioxidant and anti-inflammatory functions to regulate the body, and surprisingly, adsorbed Human Serum Albumin and Fibrinogen better than the group version, indicating significant interaction between the biomaterials and tissues. Adding the cross-linker improved the structure and heat resistance, while pumpkin pulp extract improved how the material responds to wound-related activities. Additionally, GG-MS@P3 performed better at withstanding heat, supporting gas exchange inside, gaining increased mechanical properties, breaking down positively and showing a pH-adjusted swelling capacity helpful in handling exudates. Because of these features, moist healing and controlling exudate are both possible. For this reason, GG-MS@P3 sponges offer ideal features as wound dressings due to their management of physicochemical and biological interactions, bridging a gap for new materials in the field.

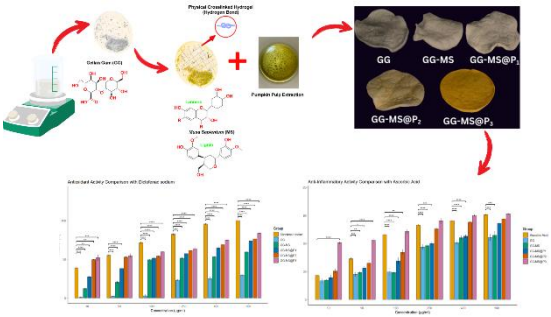

Fig. 1. Synthesis and fabrication of Sponges based on Gellan gum/Musa sapientum/Cucurbita maxima with their antioxidant and anti-inflammatory activity

This work was supported by the National Science Centre, Poland, grant UMO-2022/47/D/NZ7/01821. The authors are members of the Centre of Excellence "Towards Personalised Medicine" operating under the Excellence Initiative - Research University.

QUATERNARY AMMONIUM SALTS IN HEALTHCARE - ANTIMICROBIAL ACTIVITY OF NEWLY SYNTHESIZED CATIONIC SURFACTANTS

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With the increasing antibiotic resistance among clinically significant strains such as *Staphylococcus epidermidis*, *Pseudomonas aeruginosa*, and *Candida albicans*, the search for alternative substances has become crucial. Quaternary ammonium salts (QAS) as cationic surfactants exhibit biological activity, providing antibacterial properties.

The presented results come from studies of QAS groups with varying chemical structures (two gemini QAS and one multifunctional) in terms of activity. Initially, the ability to inhibit growth was examined by determining the minimal inhibitory and bactericidal/fungicidal concentrations. The next stage involved assessing the ability of QAS to coat abiotic surfaces (stainless steel, silicone, polystyrene), consequently inhibiting pathogen cell adhesion.

Promising results indicate significant application potential, preliminarily confirmed by safety studies – hemolysis tests of sheep erythrocytes. The gemini compound $2xC_{10}AAG_3$ exhibited inhibitory and bactericidal effect at a concentration of 5 μM, while $2xC_{14}AAG_3$ inhibited growth at 20 μM and showed bactericidal activity at 40 μM against *S. epidermidis*, though they showed no anti-adhesive effect. The multifunctional $2xC_{12}AA$ did not exhibit inhibitory effects but demonstrated high anti-adhesive efficacy, completely preventing *C. albicans* adhesion to the tested surfaces and significantly (up to 80 %) reducing the adhesion of other strains (previously published in [1]).

The high anti-adhesive efficacy and low hemolytic activity (up to 8 % at the highest tested concentration) indicate both safety and effectiveness, which may contribute to patient protection, for example, by coating medical equipment (such as catheters) to prevent nosocomial infections, where gemini compounds could effectively function as surface and skin disinfectants.

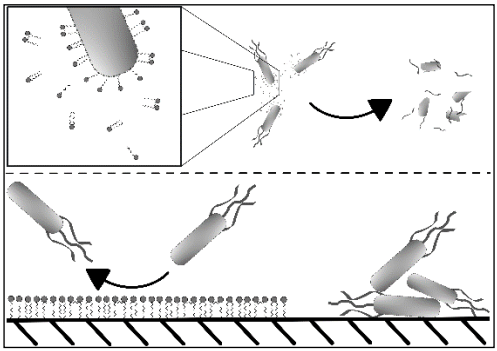

Fig. 5. Antimicrobial and anti-adhesive activity of QASs [1].

Research supported by NCS OPUS16 Grant No. 2018/31/B/NZ9/03878 (principal investigator - EO)

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POLYSACCHARIDE-BASED DRESSING SPONGES ENRICHED WITH *CLITORIA TERNATEA* EXTRACT AND PAPAIN NANOSTRUCTURES AS POTENTIAL SUPPORT IN BATTLEFIELD AND EMERGENCY MEDICAL CARE

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The realities of modern battlefield medicine and emergency medical response require wound dressing materials that are lightweight, easy to use, bioactive, and effective under conditions of limited infrastructure. To address these needs, innovative sponge-like dressing materials were developed based on polysaccharides – sodium alginate and fucoidan – crosslinked with ferulic acid (at concentrations of 5% and 12%) and enriched with *Clitoria ternatea* extract and papain nanoflowers. The materials were obtained using a freeze-drying method, resulting in porous, lightweight, and highly absorbent sponges suitable for transport and field application. Comprehensive physicochemical and biological analyses were conducted on the obtained structures. SEM imaging confirmed high porosity, and swelling tests demonstrated rapid fluid absorption, essential for hemorrhage control and wound stabilization. The active additives exhibited antioxidant and anti-inflammatory properties, with higher concentrations of ferulic acid enhancing these effects while maintaining cellular safety. ATR-FTIR and TGA analyses confirmed the chemical and thermal stability of the sponges, which is crucial for their storage and transport under field conditions. Additionally, mechanical tests demonstrated the materials' adequate elasticity and tensile strength, essential for their practical application as wound dressings. Cytotoxicity studies confirmed good biocompatibility of the obtained sponges, indicating their safety in contact with skin cells. Thanks to the synergy of natural components and functional physical properties, the developed dressing sponges represent an innovative platform for use in acute trauma scenarios in combat situations and civilian rescue operations. Their structure allows for immediate application without prior preparation, making them highly practical in environments with limited access to specialized medical care. The developed material represents a step toward advanced, next-generation bioactive wound dressings designed for extreme conditions.

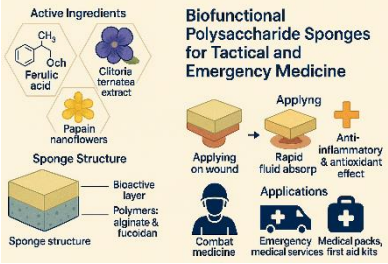

Fig. 1. Simplified scheme of the research work.

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BIOMATERIALS CROSSLINKED WITH DIALDEHYDE INULIN AND ENRICHED WITH PLANT EXTRACT AS-POTENTIAL WOUND DRESSING MATERIALS

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Due to the increasing incidence of wounds, there is an urgent need to develop new and effective treatment methods that can accelerate the healing process, reduce the risk of infection, and minimize complications [1]. The aim of our work is to create a sponge with properties that support the wound healing process through the synergistic action of individual components. This study develops new materials based on a mixture of inulin, mannan, and sodium alginate, and cross-linked with dialdehyde inulin. The materials are enriched with vitamin B12 and plant extracts. Natural polymers, such as inulin, act as structural matrices that retain moisture and promote tissue regeneration, while minimizing the risk of allergic reactions [2, 3]. Inulin acts as a stabilizer, providing the appropriate mechanical properties for the potential wound dressing. Mannan and sodium alginate form a matrix that ensures a moist environment necessary for optimal healing. Dialdehyde inulin offers advantages as a wound dressing cross-linker due to biocompatibility and biodegradability [4]. Its natural source and reduced toxicity versus glutaraldehyde make it ideal for advanced wound dressings. Plant extracts contain bioactive compounds that can stimulate tissue regeneration, soothe irritation, and protect against infection. Vitamin B12 stimulates cell proliferation, which can accelerate tissue regeneration, and *Erysimum cheiranthoides* extracts exhibit strong anti-inflammatory (85.88%) and antioxidant (91.65%) effects, which are crucial in preventing wound infections [5,6].

This work was supported by the National Science Centre Poland grant UMO-022/47/D/NZ7/01821.

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SECTION OF PHYSICAL AND TECHNICAL SCIENCES
ORAL PRESENTATIONS

SURVIVAL AND METABOLIC RESPONSE OF GLIOMA CELLS TO FLASH IRRADIATION: PRELIMINARY RESULTS FROM SF AND MTT ASSAYS

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This study presents preliminary findings on the survival and metabolic response of glioma cells subjected to FLASH irradiation, assessed using clonogenic test and MTT assay. The aim was to characterize cellular sensitivity to high-dose-rate exposure and establish a reference point for future comparisons with conventional radiotherapy.

The experiments were conducted using the human glioblastoma-derived M059K cell line, selected for its known hypersensitivity to DNA-damaging agents and its widespread use in studies on radiation-induced stress responses and DNA repair mechanisms [2].

Irradiation was performed at the National Centre for Nuclear Research in Świerk using an accelerator dedicated to intraoperative radiotherapy with FLASH mode. Glioma cells were exposed to single doses ranging from 1 to 11 Gy in three independent biological replicates. A non-irradiated control group (0 Gy) was included too.

Cellular responses were quantified using two complementary approaches. The clonogenic assay measured long-term survival potential by evaluating the ability of individual cells to form colonies post-irradiation. In parallel, the MTT assay assessed cell viability by measuring metabolic activity. FLASH radiotherapy, characterized by ultrashort exposure times and exceptionally high dose rates, has emerged as a promising alternative to conventional fractionated radiotherapy. It offers the potential to enhance tumor control while reducing adverse effects on healthy tissue [1]. Given these properties, understanding the biological impact of FLASH on glioma cells is of high relevance for advancing radiotherapeutic strategies.

The combined results from SF and MTT assays provide early insight into glioma cell behavior under FLASH conditions and form the basis for ongoing investigations comparing biological effectiveness between FLASH and standard radiation therapy.

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DARK FERMENTATION OF STARCH-BASED EFFLUENTS FOR HYDROGEN PRODUCTION

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Wastewater generated during textile sizing is more than just an environmental burden – it represents an untapped bioenergy resource. This study explores whether such starch-rich effluents, both natural and chemically modified, can serve as effective substrates for hydrogen production through dark fermentation [1]. All fermentations were conducted at 37°C, while the substrates themselves underwent different thermal pretreatments: either preheated to 70°C or left unheated. Results revealed that unheated natural starch produced the highest hydrogen yields, while modified starches – despite lower H_2 outputs – activated alternative microbial pathways, leading to the formation of longer-chain fatty acids and reduced CO_2 levels.

These findings go beyond laboratory curiosity. They highlight the potential of textile industry waste to be repurposed into green energy and value-added biochemicals. Moreover, a strong correlation between starch type, gas composition (H_2/CO_2 ratio), and the dominant metabolic routes was observed [2]. This insight could inform the design of tailored fermentation systems optimized for specific end-products. Ultimately, this work opens new perspectives for integrating biohydrogen production into circular economy models within the textile sector.

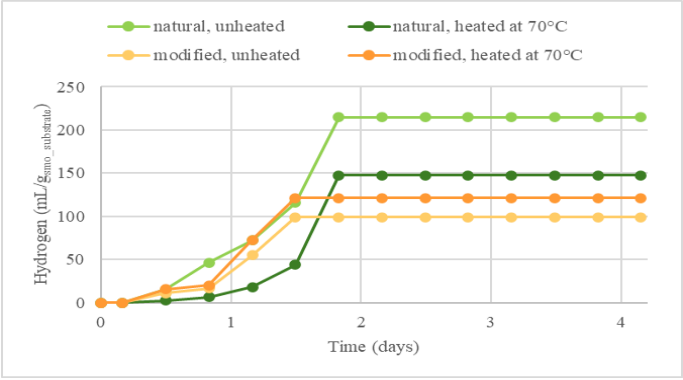

Fig. 1. Cumulative hydrogen production over time during dark fermentation of starch-based sizing wastewater

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HALIDE PEROVSKITE SINGLE CRYSTALS AS EMERGING SCINTILLATORS FOR RADIATION DETECTION APPLICATIONS

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Halide perovskites have recently attracted considerable attention as next-generation materials for radiation detection due to their tunable optoelectronic properties, high radioluminescence yield, and ease of crystal growth. This work explores the potential of methylammonium lead bromide ($MAPbBr_3$) single crystals, doped with lithium (Li) and rubidium (Rb), as efficient scintillators. Single crystals were synthesized using two distinct solution-based growth techniques, and their scintillation performance was systematically investigated under varying temperature conditions. Radioluminescence measurements revealed strong excitonic emission and enhanced thermal stability, particularly in Li-doped crystals. Thermoluminescence studies indicated minimal trap-state contributions, suggesting high radiative efficiency. Notably, the Li-doped samples grown via a tetrahydrofuran-assisted method (THF-0.4M) exhibited a significant increase in light yield - up to 2.4 times higher compared to the control samples (Control-1M), highlighting the role of doping and synthesis methods in optimizing performance. These findings demonstrate the excellent scintillation performance of Li- and Rb-doped $MAPbBr_3$ single crystals, as an efficient scintillator for advanced radiation detection technologies, especially under cryogenic conditions.

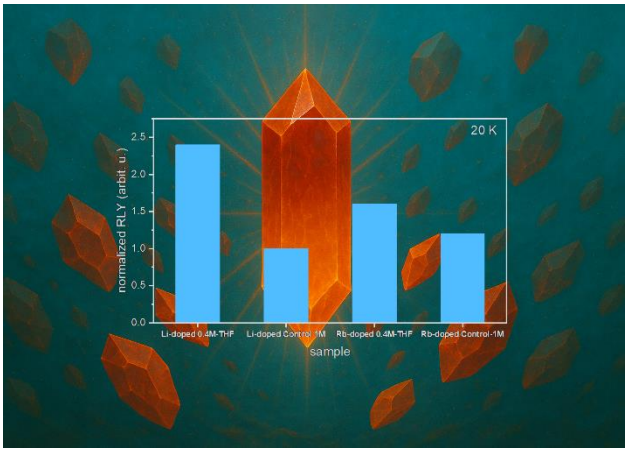

Fig. graphical abstract.

PHARMACEUTICAL CONTAMINANTS IN WASTEWATER: RISK ASSESSMENT AND BIODEGRADATION APPROACHES

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For many years, there has been a systematic increase in the consumption of pharmaceuticals in society, which poses a significant challenge to both health systems and the environment [1]. The primary factors contributing to this phenomenon are: the progressive aging of the population, increasing access to medical services, and the growing tendency of self-medication [2]. As these trends are expected to continue, the volume of pharmaceuticals entering circulation is expected to increase further.

The increase in the consumption of pharmaceuticals translates into their increasing contribution to environmental pollution, with a particular focus on the aquatic environment [3,4]. Pharmaceuticals are primarily introduced into the environment via municipal wastewater, which ultimately flows into surface waters [5]. Standard wastewater treatment technologies are not completely effective in eliminating many active substances. Their metabolites and chemical and biological transformation products generated both in human organisms and in the conventional wastewater treatment plant, also have a significant role to play [6].

An experimental study was carried out to evaluate the efficiency of biological removal of selected pharmaceuticals from a model wastewater stream using a Sequencing Batch Reactor (SBR). Pharmaceuticals from the group of non-steroidal anti-inflammatory drugs (NSAIDs) - ibuprofen (IBF) and diclofenac (DFC) - were selected. The experiment was conducted at three different concentrations of pharmaceuticals in the model effluent: 4, 10, and 20 mg/L. In addition, the formation of by-products and potential transformation compounds was monitored.

The results obtained showed a high efficiency of the biodegradation process of ibuprofen in the system used, confirming that the dominant mechanism of elimination of this substance was microbial activity. Diclofenac showed a different character - its concentration did not change significantly during the experiment, and even its gradual accumulation in the bioreactor was observed. This may indicate its limited biodegradability under the conditions of the technological process used.

Financial support from the National Science Centre (Poland) under project number 2021/43/B/ST8/001854 is acknowledged.

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ON STRAIN-RATE DEPENDENT MECHANICAL RESPONSE OF ADDITIVELY MANUFACTURED INCONEL 625 ALLOY

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Nickel-based superalloys are widely used in various sectors, such as aerospace, nuclear, petroleum and chemical, among others. Much of their commercial success is due to their enhanced mechanical properties in conjunction with outstanding oxidation and corrosion resistance when exposed to harsh environments[1,2]. However, traditional manufacturing of nickel-based superalloy structures with complex geometries has proven to be time consuming and expensive. In comparison, newly emerging techniques of Additive Manufacturing (AM) can address these limitations, thereby enabling direct manufacturing of parts with complex designs, as well as limited material and chemical waste. The AM manufacturing process, however, often faces trade-offs between thermally-induced residual stresses and stress-free yet porous matrix in their microstructures. To enable a wider adoption of AM in industry, it is necessary to better understand the resulting materials (i.e., structural and microstructural features) and their mechanical behaviour when subjected to various mechanical load. In this research, 3D printing was undertaken using the FDM method and a filament that allows obtaining a finished model from metal, after appropriate post-processing. Samples were prepared for various types of measurements. Static and dynamic tests were performed, which allowed describing the material from various perspectives. A number of tests were also performed using an electron microscope and an X-ray diffractometer. The research shows the differences between solid and printed material.

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BIODEGRADABLE COMPOSITES WITH CARBON NANOTUBES OBTAINED BY EXTRUSION

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The excellent strength and thermal properties of carbon nanomaterials make them promising fillers for polymer composites. Carbon nanotubes are approximately 1000% stronger than steel. Their tensile strength reaches a value of around 100 GPa. Equally impressive is their thermal conductivity of 6600 $Wm^{-1}K^{-1}$.

In order to develop a composite based on a biodegradable polymer with the addition of nanomaterials in the form of carbon nanotubes, it is necessary to solve the problem of agglomeration and the difficulty of precise nanofiller dosing, which is related to the low bulk density and high dusting, as well as the unsuitability of processing equipment.

The overarching goal of the presented work was to develop a technology for producing biodegradable polymer nanocomposites modified with carbon nanotubes, characterized by increased mechanical strength compared to pure biopolymers, and to prepare for the implementation of the obtained composites within the Łukasiewicz Research Network – Institute of Polymer Materials. The developed composites are planned for production in the form of granules for injection molding, filament for 3D printing, or concentrates for further processing [1-3].

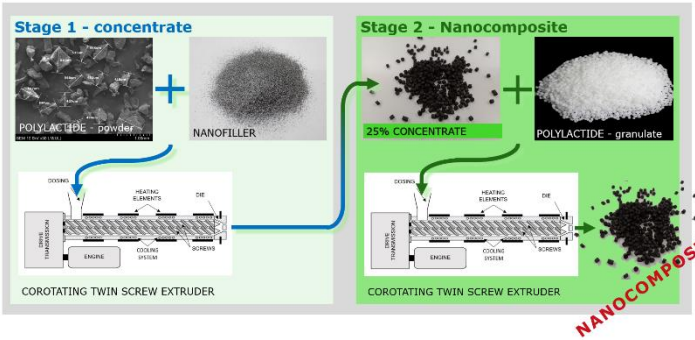

Fig. 1. Biodegradable nanocomposite preparation scheme.

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STRESS TENSOR FROM TRACE ANOMALIES

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The conformal variation of the renormalized vacuum expectation value of the stress tensor is uniquely determined by its trace anomaly (also known as the conformal anomaly) [1]. For conformally invariant quantum fields, the trace anomaly comprises three components: conformal invariants, the Euler form, and trivial anomalies [2]. Focusing on the contribution from the Euler form, one can show that the conformal variation of the stress tensor is given by the conformal variation of a specific tensor constructed from the Weyl and Schouten tensors. We have derived a general formula for this tensor in arbitrary even-dimensional spacetimes. The results obtained from this formula are consistent with previous calculations in two-, four-, and six-dimensional spacetimes [1-3]. Moreover, we have developed a diagrammatic method to compute this tensor systematically.

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FABRICATION AND CHARACTERIZATION OF PROTOTYPE SOLAR CELLS BASED ON PEROVSKITE

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Renewable energy sources are major improvement to technological development nowadays and a huge step forward to limit or even ceasing in long term the use of non-renewable energy sources, which are limited and not environmentally friendly. According to data collected in USA, 2016 [2], the renewable sources allow for supplying 15% of global electrical energy use.

Photovoltaics (PV) are one of the main types of renewable sources. Photovoltaics are based on solar cells which convert the solar energy into electrical energy. The most commonly used, silicon solar cells, already reached efficiency of 30% and this value is close to their theoretical limit [3]. For this reason new solutions are being sought based on alternative methods of solar cells fabrication or usage of different materials. One of such solutions are thin film solar cells based on perovskites – materials extraordinarily efficient in solar energy conversion. Due to their thin-layer structure of the order of hundreds of nanometers, manufacturing solar cells can be relatively cheap and their elasticity allows it to be deployed on various surfaces unlike the silicon solar cells. In a few years efficiency of solar cells based on perovskite increased from 3,8% to 22,1% [2]. The downside of perovskites is their susceptibility to moisture and temperature which causes their degradation. Some materials, such as lead, allow to obtain stable and efficient structures but as used could get into environment and poison water. The key issue then is to find the solution of efficient, stable and harmless to environment PV cells which cost of production is minimal and their applicability is wide.

In this work the author explains the process of manufacturing the prototype thin film perovskite solar cells and the characterization of such are shown. It includes U/I characterization, transmission, defining energy bandgaps and the efficiency of fabricated solar cells. The perovskite used in the work is $CsPbI_3$.

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EPR IMAGING AS A TOOL FOR QUANTITATIVE ASSESSMENT OF TUMOR TISSUE OXYGENATION *IN VIVO*

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The unique capabilities of Electron Paramagnetic Resonance (EPR) spectroscopy enable precise, non-invasive monitoring of oxygen concentration changes in living tissues based on the signal from paramagnetic probes. In this study, EPR oximetry was employed to quantitatively assess tumor oxygenation in various preclinical models using both solid (LiNc-BuO/OxyChip) and soluble (OXO71) probes.

Partial pressure of oxygen (pO_2) was measured using a pulse EPR spectrometer (Jiva-25, O2M Technology, Chicago, USA). Two types of oximetric probes were used: LiNc-BuO cristals (OxyChip) for single point oximetry and the soluble trityl radical OXO71 for 3D imaging of pO_2 distribution. Tumors inoculated in mice included an orthotopic pancreatic ductal adenocarcinoma (PanO2) model as well as ectopic tumors of PanO2 and melanoma (Mel270).

Relaxation time analysis confirmed the high sensitivity of the method in detecting tumor microenvironmental changes. Ultrasound imaging provided complementary data on tumor vasculature and structure, supporting the interpretation of the oximetry results.

EPR imaging enables quantitative, dynamic, and non-invasive evaluation of tumor tissue oxygenation in vivo. The use of probes such as OxyChip and OXO71 allows for real-time tracking of hypoxia, which may be critical for predicting treatment response and designing personalized therapeutic strategies. EPR-based oxygen imaging offers the ability to map pO_2 with high spatial and temporal resolution across various tumor types.

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DYNAMIC OPTICAL TRAPPING OF HYDROGEN MOLECULES IN A CRYOGENIC REGIME

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The hydrogen molecule (H_2) poses significant experimental challenges due to its lack of a permanent dipole moment and simple ground-state structure making it inaccessible to standard laser cooling and trapping techniques [1,2]. Recent advances in high-power lasers and cryogenic technology have opened the way to alternative methods of cooling molecules [3–5]. These new approaches make H_2 a particularly promising target for precision spectroscopy and fundamental studies of quantum electrodynamics (QED).

This project focuses on developing an optical system for trapping H_2 molecules using a dynamic optical trap. Our approach relies on rapidly switching a high-power intracavity laser field to create a time dependent trapping potential suitable for buffer-gas-cooled H_2. The setup includes an ultra-stable optical cavity, Pound-Drever-Hall locking technique of a 1064 nm Continuouslu Tunable Laser amplified to 50 W, and fast modulation using an acousto-optic modulator. Key challenges involve high-power stability, synchronized switching, mirror heating [6], and cryogenic thermal management.

This technique will allow us to trap H_2 molecules at a few kelvin using commercial cryocoolers, offering the potential for spectroscopic precision far beyond current gas-phase experiments [7], and supporting high-accuracy QED tests.

This work is part of the author's MSc thesis under the supervision of Prof. Piotr Wcisło.

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ASSESSMENT OF THE FLAMMABILITY AND SMOKE EMISSION OF FLEXIBLE POLYURETHANE FOAMS DERIVED FROM A GREEN BIO-POLYOL

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In the face of increasing environmental awareness and the increasing need to find ecological alternatives to petrochemical raw materials used in the production of polyurethanes, more and more attention is being paid to natural seed oils. They can serve as a source of eco-friendly polyols for foam production. This study focuses on the synthesis and evaluation of the flammability and smoke emission properties of flexible polyurethane foams (FPUfs) produced with increasing content of bio-polyol obtained from mustard seed oil [1-3].

Mustard oil is a renewable and easily available raw material. It constitutes a valuable source for the synthesis of sustainable polyols, enabling the development of environmentally friendly polyurethane materials. The flammability and smoke emission properties of the FPUfs were analyzed using a cone calorimeter method in accordance with ISO 5660:2015 standard. The use of renewable raw materials, such as vegetable oils, is an example of actions consistent with the principles of the green chemistry and sustainable development doctrine, that efforts aimed at reducing the negative impact of industry on the natural environment [1-2].

The conducted research emphasizes the importance of ecological polyurethane foams as an alternative to traditional polyurethane materials derived from petroleum-based polyols, supporting the development of technologies aligned with the idea of sustainable development.

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ELECTROCHEMICAL PROPERTIES OF CARBON NANOTUBES AND GRAPHENE DECORATED WITH NANODIAMONDS

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The oxygen reduction reaction (ORR) is a key process in energy conversion and storage devices such as fuel cells and metal-air batteries [1]. The efficiency of the cathodic ORR depends on the electrocatalytic properties of the electrode material. Multi-walled carbon nanotubes (MWCNTs), due to their high electrical conductivity and large surface area, are considered attractive electroactive materials [2].

One of the major challenges during preparation of 3D electrodes from water suspension is the tendency of MWCNTs to aggregate. To improve stability of MWCNT dispersions, surfactants such as cocamidopropyl betaine (CAPB), sodium lauryl sulfate (SLES) and sodium dodecyl sulfate (SDS) were employed [3] [4]. The tubule suspension is additionally stabilized by nanodiamonds (ND), as well.

Here, we show that inks consisting of bare OH-MWCNTs and MWCNTs have better catalytic properties for ORR, than ND-decorated nanotubes. The number of electrons transferred decreases by one after deposition of NDs. On the other hand, a specific surface area of bare OH-MWCNTs of 152 m^2/g increases after ND deposition to 254.36 m^2/g. We attribute this behavior to the acceptor properties of nanodiamonds, which suck electrons from nanotubes, so that their ability to catalyze reduction reactions decreases.

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HYPERPARAMETER OPTIMIZATION AND COMPARATIVE EVALUATION OF LEARNING ALGORITHMS FOR SPIKING NEURAL NETWORKS ON MNIST: A STUDY OF ANN-TO-SNN CONVERSION, SURROGATE GRADIENT BACKPROPAGATION, AND TEMPOTRON LEARNING

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This study compares three SNN training methods on MNIST: ANN-to-SNN [1], surrogate gradient backpropagation [2], and Tempotron learning [3]. All were trained under identical conditions. Key hyperparameters were optimized using Optuna, and the best configurations were used for retraining.
This two-stage approach improved accuracy and stability. ANN-to-SNN offered solid baseline performance, BP_Surspike achieved higher accuracy with greater cost, and BP_Tempotron balanced biological realism and efficiency.

These results confirm that learning method choice strongly affects SNN performance. Hyperparameter optimization, supported by Optuna, was key to achieving accuracy and training stability. The study also shows how Tempotron, surrogate gradient backpropagation, and ANN-to-SNN can complement each other in hybrid, biologically plausible SNN frameworks [4].

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EYE IN MOTION: MAPPING OCULAR PULSATION WITH SS-OCT

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Purpose: Ocular tissue undergoes subtle, rhythmic displacement due to heartbeat-induced intraocular pressure (IOP) fluctuations. The primary aim of this study is to identify and analyze ocular pulsations in the cornea, crystalline lens, and retina induced by pulsatile blood flow, using long-range Swept-Source Optical Coherence Tomography (SS-OCT). Conventional OCT systems lack the imaging range to capture the entire eye. In contrast, long-range Swept-Source OCT enables full-depth imaging of the cornea, lens, and retina, making it particularly useful for mapping ocular pulsations with clinical relevance.

Methods: A prototype Swept-Source Optical Coherence Tomography (SS-OCT) system with a sweep rate of 60kHz and a center wavelength of 1060 nm. The system offers 98 dB sensitivity and 11 µm axial resolution, enabling high-contrast, high-precision imaging of subtle changes in ocular structures. This advanced imaging device was used for in vivo imaging, acquiring detailed cross-sectional views of both anterior and posterior segments, as well as the entire internal structure of the eye.

Results: While previous studies have demonstrated the use of 4D OCT to map pulsatile tissue dynamics in the murine retina and choroid, providing insights into ocular biomechanics [1]. In this study, we applied an intensity-based analysis of repeated B-scans to extract ocular pulsations in vivo. The cornea, lens, and retina exhibited synchronous axial motion aligned with the cardiac cycle, indicating a global dynamic response of the eye to pulsatile blood flow. A water drinking test revealed a decrease in pulsation amplitude at 60 minutes post-intake, followed by a gradual return to baseline between 90 and 120 minutes [2]. These findings demonstrate that ocular pulsations are sensitive to physiological changes and can be reliably monitored using long-range SS-OCT.

Conclusion: Long-range SS-OCT enables full-depth imaging of cardiac-induced ocular pulsations in the cornea, lens, and retina. It provides a non-invasive way to assess biomechanical and vascular responses in vivo. This technique shows promise for clinical evaluation of both ocular and systemic conditions.

The study is supported by the Polish National Science Centre (2021/43/I/NZ5/03328)

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