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VISEGRAD + PROJECT – 5TH EVENT

INTERNATIONAL CONFERENCE

2–4 SEPTEMBER 2026 | SZCZECIN, POLSKA

DEVELOPMENT OF INNOVATIVE POLYMERS FOR WOUND HEALING AND OTHER BIOMEDICAL APPLICATION

BOOK OF ABSTRACTS

An international platform for sharing innovative research and advances in polymeric materials for biomedical applications.

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PROGRAMME

WEDNESDAY, SEPTEMBER 2ND 2026

Place: Medical Simulation Center, Pomeranian Medical University in Szczecin,
50 Klonowica Street, 71-240 Szczecin, Poland

8:30–09:00	**Welcome coffee & registration**
	Chair by: Anna Nowak & Paula Ossowicz-Rupniewska
09:00–09:45	**Opening Ceremony** Welcome addresses by the representatives of the Marshal's Office of the West Pomeranian Voivodeship, Rectors and Deans of the Pomeranian Medical University in Szczecin and the West Pomeranian University of Technology in Szczecin
09:45–10:00	**Overview of the Visegrad+ Project** **Prof. Anna Nowak,** Pomeranian Medical University in Szczecin, Poland **Prof. Paula Ossowicz-Rupniewska,** West Pomeranian University of Technology in Szczecin, Poland
10:00–10:45	**Plenary Lecture** **Development of hybrid hydrogel dressings for topical treatment of psoriasis: from laboratory concept to evaluation in a 3d tissue model** **Prof. Katarzyna Bialik-Wąs,** Cracow University of Technology, Poland
10:45–11:15	**Project Coordinator Lecture** **Design and development of functionalized polymer-based bandages for advanced wound therapy** **Prof. Franciska Erdő,** Pázmány Péter Catholic University, Hungary
11:15–11:35	**Project Partner Presentation I** **Modern nanoplatrorms for drug delivery and controlled release** **Dr. Olena Pavlenko,** Institute of Physics, National Academy of Sciences of Ukraine
11:35–11:55	**Project Partner Presentation II** **Evaluation of the irritation potential and wound healing efficacy of polymer hydrogel prototypes using 3d human reconstructed epidermis and skin tissue models** **Dr. Silvia Letisiova,** MatTek In Vitro Life Science Laboratories s.r.o., Slovakia
12:00–12:45	**Lunch Break**
12:45–13:05	**Lecture I** **Nutritional modulation of the wound microenvironment: clinical implications for polymer-based dressing efficacy** **Dr. Maja Czerwińska-Rogowska,** Pomeranian Medical University in Szczecin, Poland
13:05–13:25	**Lecture II** **Selected plant species with high antioxidant activity for potential use in wound healing** **Prof. Justyna Stefanowicz-Hajduk,** Medical University of Gdańsk, Poland
13:25–13:45	**Lecture III** **Maggot debridement therapy as the first stage of wound management – the importance of biological wound bed preparation, clinical experience, and the role of the nurse in preparing the wound for advanced therapies** **Dr. Jolanta Dynarska,** Medical Center Jolanta Dynarska, West Pomeranian Oncology Center,

	Poland
13:45–14:00	**Discussion and Closing Remarks – Day 1**
14:00–16:00	**Visit Medical Simulation Center**, Pomeranian Medical University in Szczecin *(Participation limited to members of the Visegrad+ Project Consortium)*

THURSDAY, SEPTEMBER 3RD 2026

Place: Medical Simulation Center, Pomeranian Medical University in Szczecin,
50 Klonowica Street, 71-240 Szczecin, Poland

8:30**–09:00**	**Welcome coffee & registration**
Chair by: Magdalena Malinowska & Barbara Roman	
09:00–09:20	**Lecture IV** **The role of the loan micellar extraction concept in the design and production of preparations containing high levels of active ingredients (on the example of cosmetics)** **Prof. Tomasz Wasilewski,** University of Radom, Poland
09:20–09:40	**Lecture V** **Development of lipid nanocarriers, polymer gels and hybrid systems enriched with extracts from fruit and vegetable biomass** **Prof. Małgorzata Miastkowska**, Cracow University of Technology, Poland
09:40–10:00	**Lecture VI** **Biological evaluation of hydrogel materials in a 3D psoriasis model: from cytotoxicity to molecular landscape** **Dr. Katarzyna Malarz,** University of Silesia in Katowice, Poland
10:00–10:20	**Lecture VII** **Parameter-controlled rotating magnetic field as a biophysical modulator of in vitro wound repair** **Prof. Rafał Rakoczy,** West Pomeranian University of Technology in Szczecin, Poland
10:20–10:40	**Lecture VIII** **Bacterial cellulose as a biocompatible platform for bacteriophage-based skin infection therapy** **Dr. Anna Żywicka,** West Pomeranian University of Technology in Szczecin, Poland
10:40–11:00	**Lecture IX** **Bacteriophages as precision antimicrobial agents for polymer-based wound healing systems** **Dr. Bartłomiej Grygorcewicz,** Pomeranian Medical University in Szczecin, Poland
11:00–11:30	**Coffee break**
Chair by: Małgorzata Miastkowska & Anna Muzykiewicz-Szymańska	
11:30–11:50	**Lecture X** **Multifunctional lupeol esters for skin barrier repair** **Prof. Magdalena Malinowska,** Cracow University of Technology, Poland

11:50–12:10	**Lecture XI** **Radiation stability of polymers used in 3D-printed boluses for megavoltage radiotherapy** **Dr. Karolina Jezierska,** Pomeranian Medical University in Szczecin, Poland
12:10–12:30	**Lecture XII** **Statistical analysis of dermatological status and measurements on nanofiber-based wound dressing mats** **Dr. János Juhász,** Pázmány Péter Catholic University, Semmelweis University, Budapest, Hungary
12:30–12:50	**Lecture XIII** **Chamomile-modified biofunctional polyurethane foams for wound care applications** **Agata Domańska, M.Sc.,** Poznan University of Technology, Poland
12:50–13:10	**Lecture XIV** **Comparative effects of selected biostimulatory components on wound closure and morphology of human dermal fibroblasts** **Maciej Gutarowicz, M.Sc.,** Pomeranian Medical University in Szczecin, Poland
13:10–13:30	**Lecture XV** **Design and application of photopolymerized gel systems for transdermal drug delivery** **Wiktoria Patz, M.Sc.,** Poznan University of Technology, Poland
13:30–14:30	**Lunch Break**
14:30–14:40	**Presentation of the Centre for Advanced Materials and Manufacturing Engineering (MATPRO)** **Prof. Rafał Rakoczy,** West Pomeranian University of Technology in Szczecin, Poland
14:40–14:50	**Presentation of the Technology Transfer Center, Pomeranian Medical University in Szczecin**
14:50–15:00	**Presentation of the Regional Centre for Innovation and Technology Transfer, West Pomeranian University of Technology in Szczecin**
	15:00–16:15 **FLASH POSTER SESSION** **Chair by: Edyta Kucharska & Barbara Roman**
15:00–15:05	**Poster 1** **Stimulus-responsive polyurethane hydrogels for controlled local delivery gemcytabine and docetaxel for pancreatic cancer therapy** **Prof. Marcin Sobczak,** Medical University of Warsaw, Poland
15:05–15:10	**Poster 2** **Photopolymer-based innovations in medical dressings: advanced hydrogels and adhesive films with enhanced moisture vapor permeability** **Prof. Agnieszka Kowalczyk**, West Pomeranian University of Technology in Szczecin, Poland
15:10–15:15	**Poster 3** **Hydrogel films based on a starch derivative and poly(acrylic acid) – preparation and evaluation of properties** **Prof. Katarzyna Wilpiszewska**, West Pomeranian University of Technology in Szczecin, Poland

15:15–15:20	**Poster 4**
	Pro-regenerative potential of *Hericium erinaceus* alcoholic extract in human dermal fibroblasts
	Dr. Patrycja Kupnicka, Pomeranian Medical University in Szczecin, Poland
15:20–15:25	**Poster 5**
	***Kalanchoe pinnata* (lam.) pres. extracts for collagenase inhibition**
	Dr. Anna Hering, Medical University of Gdańsk, Poland
15:25–15:30	**Poster 6**
	Selective modulation of skin microbiota using a topical encapsulated probiotic system
	Dr. Anna Łętocha, Cracow University of Technology, Poland
15:30–15:35	**Poster 7**
	Hybrid polymer–lipid nanocarriers for enhanced delivery of horse chestnut extract in wound healing and anti-edema applications
	Dr. Elwira Lasoń, Cracow University of Technology, Poland
15:35–15:40	**Poster 8**
	Plants as a promising strategy for tissue repair: insights from *Sanguisorba officinalis* l.
	Dr. Anna Muzykiewicz-Szymańska, Pomeranian Medical University in Szczecin, Poland
15:40–15:45	**Poster 9**
	Sodium alginate/hydroxyapatite composite hydrogels prepared with additive manufacture
	Dr. Magdalena Łabowska, Wrocław University of Science and Technology, Poland
15:45–15:50	**Poster 10**
	Wild strawberry (*Fragaria vesca* l.) extract as an innovative ingredient of polymer dressings supporting wound healing
	Agata Madalińska, M.Sc., Pomeranian Medical University in Szczecin, Poland
15:50–15:55	**Poster 11**
	Antioxidant film based on biopolymer and bioactive pigment as a promising combination for wound healing applications
	Patrycja Brudzyńska, M.Sc., Nicolaus Copernicus University, Poland
15:55–16:00	**Poster 12**
	Biopolymeric-based porous materials with antioxidant properties as a potential wound dressing
	Karolina Kulka-Kamińska, **M.Sc.**, Nicolaus Copernicus University, Poland
16:00–16:05	**Poster 13**
	Injectable amphiphilic polymer nanoparticles loaded with quercetin for intra-articular osteoarthritis treatment
	Nicolas Maciejewicz-Kamiński, West Pomeranian University of Technology in Szczecin, Poland

16:05–16:10	**Poster 14** **Pilot evaluation of an *Epilobium angustifolium* l. extract-containing topical hydrogel on skin biophysical parameters in healthy volunteers** **Anna Fogarasi**, Pázmány Péter Catholic University, Hungary
16:10–16:15	**Poster 15** **Sustained drug delivery carriers for intra-articular administration** **Wojciech Kucharski**, West Pomeranian University of Technology in Szczecin, Poland
16:15–17:00	**Discussion and Closing Ceremony**

FRIDAY, SEPTEMBER 4TH 2026

09:00–10:00	**Visit to the Centre for Advanced Materials and Manufacturing Engineering (MATPRO), West Pomeranian University of Technology in Szczecin** **Place:** Centre for Advanced Materials and Manufacturing Engineering (MATPRO), West Pomeranian University of Technology in Szczecin, Piastów Ave. 45, 70-311 Szczecin Presentation of research infrastructure and laboratories (Laboratory visits are available only to registered conference participants. Due to safety regulations and capacity limitations, the number of participants is limited.)
11:00–17:00	**Project Closing Meeting** **Place:** University Clinical Hospital No. 2, 72 Powstańców Wielkopolskich Avenue, 70-111 Szczecin, Poland, Building V, 1st Floor *(Participation limited to members of the Visegrad+ Project Consortium)*

ORAL PRESENTATION ABSTRACTS

POSTER PRESENTATION ABSTRACTS

ORAL PRESENTATION ABSTRACTS

DEVELOPMENT OF HYBRID HYDROGEL DRESSINGS FOR TOPICAL TREATMENT OF *PSORIASIS*: FROM LABORATORY CONCEPT TO EVALUATION IN A 3D TISSUE MODEL

Katarzyna Bialik-Wąs[1*], Paulina Sapuła[1], Katarzyna Malarz[2], Anna Mrozek-Wilczkiewicz[2], Mateusz Barczewski[3], Małgorzata Miastkowska[1], Dagmara Malina[1], Klaudia Pluta[1], Marek Michalski[4], Radosław A. Wach[5]

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Although hydrogel dressings are widely used in clinical practice, most commercially available products are based on blends of natural and synthetic polymers and lack advanced drug delivery systems containing hydrophobic therapeutic compounds. To overcome this limitation, we developed a technology for the preparation of biohybrid hydrogel dressings-based matrix incorporating naturally derived bioactive components and polymeric nanocarrier systems containing two hydrophobic synthetic drugs intended to support the topical treatment of *Psoriasis*.

The first stage of the study focused on optimizing the hydrogels preparation by selecting an appropriate crosslinking method, establishing the optimal reaction conditions, and determining the optimal concentrations of the initiator and crosslinking agent, as well as the matrix composition. These investigations were based on a comprehensive physicochemical characterization of the obtained materials, including rheological analysis, FT-IR spectra, SEM images, TG/DTG and DSC results, and mechanical testing. In addition, drug release studies were conducted, which demonstrated sustained and controlled release of the incorporated synthetic drugs, with the release kinetics described by the Korsmeyer–Peppas model. Importantly, incorporation of the nanocarrier–drug system did not affect the cross-linking process or compromise the structural, thermal, mechanical, or swelling properties of the hydrogel network.

Biological evaluation of biohybrid hydrogels confirmed their antibacterial activity and favorable *in vitro* biocompatibility. Moreover, studies in a 3D *in vitro Psoriasis* model exhibited that the biohybrid hydrogels were non-cytotoxic and exerted significant anti-inflammatory effects by downregulating IL-6 and psoriasis-associated markers (DEFB4, elafin, S100A7, and S100A12), supporting their potential for topical *Psoriasis* therapy.

In parallel, preliminary sterilization studies of the developed biohybrid hydrogel dressings have been initiated. Current efforts are focused on optimizing gamma and electron beam (EB) irradiation to achieve effective sterilization while preserving the physicochemical, thermal, and biological properties of the hydrogels, thereby facilitating their future clinical translation.

The work carried out within the framework of the project LIDER/41/0146/L-9/17/NCBR/2018.

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[4] Bialik-Wąs K., Malina D., Pluta K., Miastkowska M., Patent PL 244305, 2023.

KEYNOTE SPEAKER

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BIOGRAPHY

Dr hab. inż. Katarzyna Bialik-Wąs, professor CUT works as a scientist and academic teacher at the Department of Polymer Chemistry and Technology at the Faculty of Chemical Engineering and Technology of Cracow University of Technology. She is the co-author of 15 patents, 13 patent applications, and 33 scientific publications. She is a member of the Polish Association of Chemical Engineers (SITPChem), the Polish Society for Biomaterials, the European Society for Biomaterials, and the Polish Society of Cosmetic Chemists. Between 2019 and 2021, she served as Principal Investigator of the research project "Development of a Method for the Preparation of Biohybrid Hydrogel Materials Incorporating a Nanocarrier–Drug System as Multicompartment Dressings for the Treatment of Psoriasis," funded by the National Centre for Research and Development. She has actively participated in numerous national and international scientific conferences. Her innovative research has received multiple awards and distinctions at prestigious international invention exhibitions, including the Korea International Women's Invention Exposition (KIWIE), the International Invention Innovation Competition in Canada (iCAN), the International Trade Fair Ideas – Inventions – New Products (iENA), the International Warsaw Invention Show (IWIS), and the Taipei International Invention Show. Her research interests include modified hydrogel-based materials, micro- and nanocarriers for bioactive compounds, controlled drug delivery and transdermal systems, biohybrid hydrogels, release kinetics of active compounds, biomaterials for medical and cosmetic applications, advanced wound dressings, hydrogel facial masks and eye patches, and naturally derived bio-crosslinking agents.

DESIGN AND DEVELOPMENT OF FUNCTIONALIZED POLYMER-BASED BANDAGES FOR ADVANCED WOUND THERAPY

Franciska Erdő[1*], Amir Fahmi[2], Silvia Letasiova[3], Marek Puskar[3], Olena Pavlenko[4], János Juhász[1], Volodymyr Neimash[5], Anna Nowak[6], Paula Ossowicz-Rupniewska[7]

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Development of advanced wound care solutions requires multidisciplinary innovation combining biomaterials engineering, drug delivery, and translational biomedical research. In this context, we present recent progress in the design and development of functionalized electrospun nanofibers and active, hydrogel-based bandages for wound therapy.

Electrospinning technology enables the fabrication of nanofibrous scaffolds with a high surface-area-to-volume ratio, tunable porosity, and excellent mechanical properties, making them suitable for biomedical applications. By optimizing process parameters (e.g. voltage, flow rate, polymer properties) and employing advanced configurations, polymeric nanofibers can be engineered to serve as multifunctional drug delivery systems. Our nanofiber systems are capable of incorporating of active agents, including antibiotics, anti-inflammatory compounds, vitamins, growth factors, and biomolecules. These systems provide sustained and controllable drug release profiles, supporting improved therapeutic efficacy.

Comprehensive physicochemical and biological characterization (including morphology, porosity, tensile strength, surface wettability, drug release kinetics and safety) confirms the suitability of these nanostructured materials for biomedical use. Preliminary in vivo studies demonstrated enhanced wound healing performance, highlighting the translational potential.

In parallel, $AgNO_3$ containing hydrogels (used for treatment of military injuries in Ukraine) were also characterized and combined with plant extract components from *Epilobium Angustifolium*. The collaborative international research initiative (“Visegrad+ Wound”) has been established to foster dialogue, harmonize methodologies, and facilitate knowledge cross-border exchange between the partners. The initiative aims to generate joint publications, promote mobility, and enable the development and commercialization of innovative wound care products.

The project Visegrad+ Grant No. 22520083 was implemented with the funding of the "Visegrad+ Grants 25" application support provided by the Visegrad Fund, in cooperation with the Ministry of Foreign Affairs of the Republic of Korea.

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BIOGRAPHY

Prof. Dr. Franciska Erdő is a Full Professor and Head of the Barrier Modelling and Innovative Pharmaceutics Research Group at the Faculty of Information Technology and Bionics, Pázmány Péter Catholic University in Budapest, Hungary. She is an internationally recognized pharmacologist whose research focuses on drug delivery across biological barriers, particularly the skin and the blood–brain barrier, as well as the development of advanced pharmaceutical technologies for targeted drug delivery.

She graduated in Pharmacy from Semmelweis University, Budapest, where she also obtained her PhD in Pharmacology with highest honors. During her scientific career, she has worked at several prestigious research institutions, including the Max Planck Institute for Neurological Research in Cologne and Charité – Universitätsmedizin Berlin, as well as in pharmaceutical research and development, gaining extensive experience in both academia and industry.

Prof. Erdő is the author and co-author of more than 90 scientific publications and several patents. She actively participates in numerous international research projects and scientific collaborations and is a frequent invited speaker at international conferences. Her research group develops innovative experimental models, including microfluidic systems, skin-on-a-chip platforms, nanofiber-based drug delivery systems, and advanced in vitro models for studying drug permeation and barrier function.

Her scientific interests include transdermal and targeted drug delivery, biological barriers, barrier modelling, nanotechnology, biomaterials, microphysiological systems, pharmaceutical technology, and innovative therapeutic strategies for improving drug transport and efficacy. Through her research, teaching, and international collaborations, she continues to contribute significantly to the advancement of pharmaceutical sciences and translational medicine.

MODERN NANOPLATRORMS FOR DRUG DELIVERY AND CONTROLLED RELEASE

Olena Pavlenko[1*], Bogdan Botvynovskyi[1], Oksana Dmytrenko[1], and Volodymyr Neimash[2]

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The development of targeted drug delivery systems aims to improve drug solubility and stability, reduce systemic toxicity, and provide controlled release at the pathological site. Promising carriers include gold and silver nanoparticles, carbon nanomaterials, cerium oxide nanoparticles, Pluronic polymeric micelles, and hybrid hydrogel composites. Gold nanoparticles possess versatile surface chemistry and localized surface plasmon resonance. Gold nanorods, nanocages, and nanoshells can convert near-infrared radiation into localized heat. This effect can trigger drug release through polymer-shell reorganization, increased liposome permeability, cleavage of thermosensitive bonds, or weakening of non-covalent interactions. Such systems provide spatial and temporal control of drug release. Their effectiveness depends on nanoparticle size and shape, surface functionalization, protein corona formation, and biodistribution [1].

Silver nanoparticles can simultaneously act as drug carriers and biologically active components. The release of Ag^{+} ions, generation of reactive oxygen species, and interactions with cellular membranes determine their antimicrobial and potential anticancer activity. Polymer-stabilized and pH-responsive AgNP systems are especially promising for the local treatment of infected and chronic wounds. However, the oxidation rate, concentration of released ions, and possible cytotoxicity must be carefully controlled.

Carbon nanotubes, fullerenes, graphene, graphene oxide, and carbon quantum dots possess large specific surface areas and can bind aromatic drug molecules through π–π stacking, hydrophobic, and electrostatic interactions. Functionalization with polyethylene glycol, proteins, or targeting ligands improves their dispersibility and biocompatibility. Drug release may be activated by changes in pH, cleavage of redox-sensitive bonds, or photothermal heating.

Cerium oxide nanoparticles combine carrier properties with redox activity arising from Ce^{3+}/Ce^{4+} transitions and oxygen vacancies. Depending on pH and the biological environment, they may exhibit antioxidant or pro-oxidant effects. This provides opportunities to develop systems in which drug release is accompanied by regulation of oxidative stress and stimulation of tissue regeneration.

Pluronic F127 and F68 micelles, formed by PEO–PPO–PEO block copolymers, can encapsulate both hydrophobic and hydrophilic drugs. Gemcitabine, cytarabine, and hydroxyurea show more efficient incorporation into F127 micelles than into F68 micelles. Following dilution of the micellar system, the drugs are released and interact with serum albumin without significant disruption of the protein structure [2].

An important research direction is the incorporation of nanoparticles and pharmaceutical molecules into hydrogels. Their high water content and porous structure create a favorable environment for local drug delivery. The addition of AgNPs, AuNPs, CeO_2, or carbon nanomaterials makes it possible to combine diffusion-controlled release with pH-, temperature-, redox-, or light-responsive mechanisms. The hydrogel matrix stabilizes nanoparticles, reduces initial burst release, and provides prolonged therapeutic action. Silver-containing hydrogel dressings are particularly promising for wound treatment, whereas gold nanoparticle composites may enable photothermally controlled drug release.

Previous studies of drug–protein–nanoparticle systems demonstrated that nanoparticles can modify the stability and interaction mechanisms of pharmaceutical molecules with serum albumin [3, 4]. Thus, current research is shifting from individual nanoparticles toward multicomponent systems combining nanoparticles, drugs, polymers, and

proteins. Further development requires detailed investigation of drug binding and release mechanisms, colloidal stability, protein corona formation, biodegradation, toxicity, and therapeutic efficiency.

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BIOGRAPHY

Prof. Dr. Olena Pavlenko is a Professor at the Department of Physics of Functional Materials, Taras Shevchenko National University of Kyiv, Ukraine. She holds a Doctor of Sciences degree in Thermophysics, Molecular Physics and Biophysics and has more than 17 years of teaching and research experience in the field of functional materials and nanotechnology.

She has led and participated in numerous national and international research projects funded by the Ministry of Education and Science of Ukraine, the NATO Science for Peace and Security (SPS) Programme, and the International Visegrad Fund. She actively collaborates with international research teams and regularly presents her work at scientific conferences and seminars.

Prof. Pavlenko is the author and co-author of numerous peer-reviewed scientific publications and a scientific monograph. Her research focuses on hybrid nanomaterials, polymer nanocomposites, carbon nanostructures, metal nanoparticles, molecular complex formation, optical spectroscopy, and nanocarrier systems for drug delivery. Her recent studies investigate the interactions between pharmaceutical compounds, proteins, and nanoparticles, as well as the development of silver nanoparticle-containing hydrogel dressings for wound healing and other biomedical applications. Through her interdisciplinary research, she contributes to the advancement of nanomaterials and innovative therapeutic technologies.

EVALUATION OF THE IRRITATION POTENTIAL AND WOUND HEALING EFFICACY OF POLYMER HYDROGEL PROTOTYPES USING 3D HUMAN RECONSTRUCTED EPIDERMIS AND SKIN TISSUE MODELS

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Polymer hydrogels have emerged as promising wound dressing materials due to their high water content, biocompatibility, and ability to maintain a moist environment that supports tissue repair. Prior to clinical application, their safety and regenerative potential must be thoroughly evaluated. This study investigated the irritation potential and wound-healing efficacy of novel polymer hydrogel formulations using 3D reconstructed human skin tissue models as an alternative to animal testing.

The irritation potential of the hydrogel prototypes was assessed in the EpiDerm™ Skin Irritation Test (SIT) in accordance with OECD Test Guideline 439 and the EpiDerm™ Skin Irritation Test for Medical Device Extracts (SIT-MD) according to ISO 10993-23 using 3D reconstructed human epidermis tissue model, EpiDerm. Wound-healing efficacy was evaluated in the 3D reconstructed human skin tissue model, EpiDerm full-thickness tissue model (EpiDermFT™) over a 7-day culture period. Tissue viability was determined using the MTT assay, while histological analysis was performed to assess tissue morphology, re-epithelialization, and wound closure.

All hydrogel formulations were classified as non-irritants in both the EpiDerm™ SIT and SIT-MD assays, with tissue viability values comparable to those of the negative controls. Histological evaluation of wounded EpiDermFT™ tissues demonstrated the wound closure and re-epithelialization in hydrogel-treated samples, indicating favorable effects on tissue regeneration.

These findings demonstrate that reconstructed human skin models provide a reliable and physiologically relevant platform for the preclinical assessment of wound dressing biomaterials. The tested polymer hydrogels exhibited excellent skin compatibility and promising wound-healing properties, supporting their further development as safe and effective wound management materials while advancing the implementation of non-animal testing strategies.

The work was conducted within the framework of the Visegrad+ Grant No 22520083, with the funding of the ”Visegrad+ Grants 25” application support provided by the Visegrad Fund, in cooperation with the Ministry of Foreign Affairs of the Republic of Korea.

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Dr. Silvia Letasiova is the Managing Director and Senior Scientist at MatTek In Vitro Life Science Laboratories (MatTek IVLSL), Bratislava, Slovakia. She holds a PhD in Biochemistry and has extensive expertise in biochemistry, microbiology, and advanced in vitro tissue engineering.

She joined MatTek IVLSL in 2008 as a Project Manager and Scientist and has since been actively involved in the development and production of highly reproducible and predictive three-dimensional reconstructed human tissue models for in vitro topical toxicity testing. Her work focuses on the development, optimization, and validation of alternative testing methods that support the reduction and replacement of animal experiments.

Dr. Letasiova is responsible for numerous research and development projects in the fields of skin and eye irritation, corrosion, phototoxicity, and skin sensitization. She is an active member of several international scientific societies, including the European Society of Toxicology In Vitro (ESTIV), the Slovak Toxicology Society (SETOX), the European Society for Alternatives to Animal Testing (EUSAAT), and a full member of the Society of Toxicology (SOT, USA).

She is the co-author of more than 30 peer-reviewed scientific publications, with over 1,400 citations and an h-index of 20. She has presented her research in more than 150 oral and poster presentations at national and international scientific conferences. Her scientific interests include in vitro toxicology, reconstructed human tissue models, alternative methods to animal testing, tissue engineering, and the development of predictive assays for evaluating the safety of pharmaceuticals, cosmetics, medical devices, and chemicals.

NUTRITIONAL MODULATION OF THE WOUND MICROENVIRONMENT: CLINICAL IMPLICATIONS FOR POLYMER-BASED DRESSING EFFICACY

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The efficacy of advanced wound dressings, including hydrogels, biopolymer scaffolds, and polymer-based antimicrobial membranes, is evaluated primarily in material science terms: adhesion, porosity, moisture balance, and drug release kinetics. However, a critical and frequently overlooked determinant of dressing performance is the biochemical state of the wound microenvironment, which is profoundly shaped by the patient's nutritional status. This presentation addresses the mechanistic interface between clinical nutrition and the tissue conditions in which polymer-based materials must function.

Burn injury provides an extreme and well-characterised clinical model. Severe thermal trauma triggers a hypermetabolic response associated with accelerated protein catabolism, acute-phase micronutrient redistribution, and systemic inflammation. Data from the West Pomeranian Centre of Treating Severe Burns demonstrate that over 90% of burn patients present with 25-hydroxycholecalciferol deficiency on admission, with serum albumin levels strongly predictive of vitamin D status throughout the acute phase. Simultaneously, burn extent correlates with significant depletion of antioxidant trace elements, zinc, copper, and selenium, alongside accumulation of pro-inflammatory toxic elements in serum. These shifts do not merely reflect systemic illness; they directly alter wound bed biochemistry in ways that impair collagen cross-linking, keratinocyte migration, angiogenesis, and local immune defence, the very biological processes that polymer scaffolds aim to support.

Beyond burns, the same principle applies across the spectrum of complex wounds encountered in clinical practice: oncological wounds, pressure injuries, and post-surgical defects in malnourished patients. Hypoalbuminaemia reduces oncotic pressure and creates oedematous wound beds with impaired oxygen delivery. Zinc deficiency delays epithelialisation. Glutamine depletion compromises intestinal barrier integrity, increasing systemic endotoxin load and sustaining the pro-inflammatory milieu. In each of these scenarios, the wound microenvironment into which a polymer-based dressing is applied is fundamentally different from that observed in well-nourished experimental models.

This presentation argues for a paradigm shift in how polymer-based dressings are conceptualised, tested, and applied clinically: nutritional status should be considered a key biological variable in preclinical wound model design and a necessary component of clinical wound assessment protocols. Screening for malnutrition, targeted supplementation of micronutrients critical to wound biology, and enteral nutrition strategies that protect intestinal barrier function are not adjuncts to wound care — they are prerequisites for the materials to perform as designed. Integrating clinical nutrition into biomaterial wound healing research represents an underexplored but high-yield avenue for improving translational outcomes.

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BIOGRAPHY

Dr. Maja Czerwińska-Rogowska is a clinical dietitian and researcher with more than 10 years of experience in hospital nutrition. Her professional and scientific work focuses on burns and critical care, oncological nutrition, intestinal barrier dysfunction, and nutritional support for patients with complex medical conditions.

She is an active member of the Polish Society for Parenteral, Enteral Nutrition and Metabolism (POLSPEN) and the European Society for Clinical Nutrition and Metabolism (ESPEN). She co-authored the most recent national guidelines on oncology nutrition in Poland and is the author of a monograph on nutrition in wound healing published by PZWL.

Her scientific interests include clinical nutrition, wound healing, burn care, oncological nutrition, critical care nutrition, enteral nutrition, intestinal barrier integrity, micronutrient metabolism, and nutritional strategies supporting tissue regeneration and patient recovery. Through her research and clinical practice, she contributes to the development of evidence-based nutritional interventions aimed at improving outcomes in patients with acute and chronic wounds.

SELECTED PLANT SPECIES WITH HIGH ANTIOXIDANT ACTIVITY FOR POTENTIAL USE IN WOUND HEALING

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Wound healing is a highly coordinated biological process involving hemostasis, proliferation, inflammation and tissue remodeling. Various factors, including diabetes, oxidative stress, and infection can impair this process, leading to delayed wound closure and chronic wounds. Thus, the search for safe and effective therapeutic agents promoting wound repair remains an important area of modern research. One of the targets of such research is plant species due to their rich content of bioactive phytochemicals, including phenolic compounds, flavonoids, tannins, alkaloids, terpenoids, and saponins, which can exhibit potent antioxidant properties neutralizing free radicals and reducing oxidative damage at the wound site. *Coleus aromaticus* Benth., *Kalanchoe blossfeldiana* Poelln., and *Rubus caesius* L. are plants occurring in different climatic zones and belonging to Lamiaceae, Crassulaceae and Rosaceae family, respectively. *C. aromaticus* is a commonly used plant both in folk and traditional medicine. Many studies prove its biological and pharmacological activities connected with diversified phytochemical composition of secondary metabolites, mainly phenolic acids, flavonoids, and terpenoids [1,2]. In our study, we investigated the antioxidant effect of ethanol, ethanol/water extracts, and juice of *C. aromaticus* leaves and inhibitory activity on hyaluronidase. The antioxidant potential was the highest for the ethanol extract with IC_{50} values of 13.34 ± 0.11 (ABTS), 22.90 ± 1.30 (DPPH), and 290.17 ± 4.23 µg/mL (molybdenum reducing power) [3]. The ethanol extract also showed the strongest inhibitory effect on hyaluronidase with IC_{50} 52.79 ± 0.43 µg/mL, which was similar to oleanolic acid. Preliminary HPLC analysis revealed the presence of phenolic acids and flavonoids in the *C. aromaticus* extracts, such as rosmarinic acid, caffeic acid, gallic acid, and luteolin in the ethanol and ethanol/water extracts and gallic acid in the juice. Similarly, *K. blossfeldiana* ethanol extract had strong antioxidant properties with IC_{50} values 4.21 ± 0.32, 7.72 ± 0.09, and 11.25 ± 0.17 µg/mL in ABTS, DPPH, and FRAP assays, respectively. Furthermore, active ingredients contained in *K. blossfeldiana* extract, mainly gallic acid, protocatechuic acid, and vanillic acid, penetrated through the human skin and accumulated in it [4]. This extract may be considered as a valuable factor potentially supporting wound healing. Next plant species – *R. caesius* is a small shrub commonly found throughout most of Europe and Eastern to Central Asia. Water and ethanol extracts from leaves and stems of this plant species were tested for their antioxidant properties and exhibited strong potential toward free radicals with IC_{50} values in the range of 11.66-35.63 µg/mL in ABTS assay. HPLC analysis revealed that ethanol extracts from leaves and stems were rich in phenolic acids. The permeation study showed that neochlorogenic acid and gallic acid from ethanol extract of *R. caesius* leaves exhibited the highest permeation capability [5].

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Dr. Habil. Justyna Stefanowicz-Hajduk is an Associate Professor at the Medical University of Gdańsk (MUG), where she serves as the Head of the Department of Biology and Pharmaceutical Botany at the Faculty of Pharmacy. She is also the Programme Director of the Pharmaceutical and Cosmetic Industry programme. She graduated from the Faculty of Pharmacy at MUG and obtained her postdoctoral degree (habilitation) in Pharmaceutical Sciences in 2022. Additionally, she has completed postgraduate studies in Bioaesthetic Cosmetology and Human Resources Management.

Dr. Habil. Stefanowicz-Hajduk is the author and co-author of numerous scientific publications with an H-index of 15**.** She has participated in several research projects funded by the National Science Centre (NCN) and the Ministry of Science and Higher Education (MNiSW). Her scientific achievements include the characterization of the biological activities and mechanisms of action of medicinal plants, particularly lesser-known species, as well as the evaluation of their potential biomedical applications.

Her research interests include medicinal plants, natural products, plant secondary metabolites, phytochemistry, biological activity of plant extracts, anticancer and antibacterial compounds, antioxidant and anti-ageing activity, skin regeneration, oxidative stress, and the development of plant-derived bioactive compounds for pharmaceutical and cosmetic applications.

MAGGOT DEBRIDEMENT THERAPY AS THE FIRST STAGE OF WOUND MANAGEMENT – THE IMPORTANCE OF BIOLOGICAL WOUND BED PREPARATION, CLINICAL EXPERIENCE, AND THE ROLE OF THE NURSE IN PREPARING THE WOUND FOR ADVANCED THERAPIES

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Wound healing, particularly in chronic and hard-to-heal wounds, requires a comprehensive approach that includes not only the elimination of factors impairing healing but also proper wound bed preparation before the implementation of advanced therapeutic methods. Effective removal of necrotic tissue, reduction of bacterial burden and biofilm, and stimulation of tissue repair processes are essential prerequisites for successful treatment outcomes.

Maggot Debridement Therapy (MDT), utilizing sterile larvae of Lucilia sericata, is a well-established and evidence-based biological debridement method for chronic and difficult-to-heal wounds. The mechanism of action of the larvae includes selective removal of necrotic tissue, antibacterial and antibiofilm activity, and stimulation of wound healing processes. Consequently, MDT contributes to shortening the inflammatory phase and creating optimal conditions for the subsequent use of advanced wound care technologies, including specialist dressings, negative pressure wound therapy, and regenerative treatment strategies.

The aim of this presentation is to highlight the role of MDT as the first stage of wound treatment and to discuss clinical experiences related to its application in patients with diabetic foot ulcers, venous leg ulcers, pressure injuries, and other chronic wounds requiring effective debridement before further therapeutic interventions. Particular attention will be paid to the impact of biological wound bed preparation on the effectiveness of modern wound management approaches and tissue regeneration.

An important aspect of the therapeutic process is the role of the nurse specialized in wound care. Such professionals are responsible for patient qualification, wound assessment and preparation, monitoring treatment progress, patient and family education, and coordination of interdisciplinary care. The increasing complexity of wound management and the development of Advanced Practice Nursing have expanded the scope of nursing competencies, enabling nurses to act as independent clinical experts involved in therapeutic decision-making and outcome evaluation.

Maggot Debridement Therapy represents a valuable component of contemporary wound management and can be regarded as a biological bridge between wound cleansing and the application of advanced medical technologies and biomaterials supporting tissue regeneration. Proper wound bed preparation remains one of the most critical determinants of successful clinical outcomes in modern wound care.

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Dr. Jolanta Dynarska, PhD in Medical and Health Sciences, is a specialist nurse in long-term care, healthcare manager, and wound care expert with more than 35 years of experience in clinical practice, scientific research, and healthcare management. She is the founder and owner of the Medical Center Jolanta Dynarska, a specialized wound care clinic in Szczecin, Poland, and serves as Deputy Director for Nursing at the West Pomeranian Oncology Center.

Dr. Dynarska is the Chair of the Advanced Nursing Practice Committee of the Polish Wound Management Society and the initiator of the Future Nursing Committee established within the Regional Chamber of Nurses and Midwives in Szczecin. She has led the implementation of the Primary Nursing model at the West Pomeranian Oncology Center and has coordinated numerous projects focused on healthcare quality improvement, patient safety, telecare, and the professional development of nurses.

She is a co-author of the Polish Wound Management Society Position Statement on Maggot Debridement Therapy and has contributed as an expert to the development of national recommendations on prehabilitation and comprehensive patient preparation for surgery. She is also a member of the Expert Council of the nationwide “Wounds Under Control” campaign and co-author of the Agreement for Professional Wound Care.

In recognition of her achievements in nursing innovation, Dr. Dynarska was selected as a finalist of the Queen Silvia Nursing Award 2021. Her professional interests include advanced wound management, advanced nursing practice, interdisciplinary care coordination, patient safety, healthcare quality improvement, and the implementation of innovative solutions in clinical practice.

THE ROLE OF THE LOAN MICELLAR EXTRACTION CONCEPT IN THE DESIGN AND PRODUCTION OF PREPARATIONS CONTAINING HIGH LEVELS OF ACTIVE INGREDIENTS (ON THE EXAMPLE OF COSMETICS)

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In recent years, there has been a significant increase in the number of natural cosmetics available on the market. Manufacturers, in response to consumer needs, are looking for solutions characterized by high safety of use (e.g. low drying and irritation effects). A key factor in the effectiveness of cosmetics is the high concentration of active ingredients, which are often derived from plant sources. In addition, modern cosmetics must have high functionality, affordable price, meet the assumptions of so-called sustainable products and be characterized by a limited negative impact on the natural environment.

The paper presents the results of research on the possibilities of using the Loan Micellar Extraction (LME) concept to produce natural cosmetics intended for hygiene. The essence of the method consists in borrowing components from the target cosmetic, preparing an extraction medium with their participation, carrying out the extraction (in the presented studies, micellar extraction was carried out), and then returning the obtained extract to the cosmetic mass. As a result - in the composition of a given preparation there appear ingredients isolated from the plant material, while the cosmetic mass does not contain any auxiliary substances (e.g. commonly used solvents) [1-3].

The presentation discussed the advantages and disadvantages of the new concept. The new method of producing natural cosmetics was illustrated with specific examples. It was shown that the obtained product prototypes have high application potential and are an interesting alternative to currently used solutions.

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Prof. Dr. Hab. Eng. Tomasz Wasilewski is a scientist and industry expert specializing in cosmetic chemistry, surfactant technology, and the development of innovative cosmetic and detergent products. He is a Professor at the University of Radom and serves as Research and Development Director at Onlybio.life S.A., where he combines academic research with industrial innovation.

He is a member of the Advisory Team to the Polish Minister of Science for Research Infrastructure and has served for many years as Dean and Vice-Dean for Science at the Faculty of Applied Chemistry, University of Radom. He is actively involved in numerous scientific and professional organizations, including the Main Board of the Polish Society of Commodity Science, the Academy of Engineering in Poland, and the Committee on Analytical Chemistry of the Polish Academy of Sciences. He also serves on the Supervisory Boards of Onlybio.life S.A. and Hub.tech S.A. and is a member of the Programme Board of the scientific journal Przemysł Chemiczny.

Prof. Wasilewski has extensive experience in research, development, and commercialization within the cosmetics and detergents industry, having contributed to the implementation of more than 500 cosmetic products on the market. His scientific and professional interests include cosmetic technology, surfactants, detergents, formulation science, green chemistry, industrial research and development, product innovation, and the transfer of scientific knowledge into industrial applications.

DEVELOPMENT OF LIPID NANOCARRIERS, POLYMER GELS AND HYBRID SYSTEMS ENRICHED WITH EXTRACTS FROM FRUIT AND VEGETABLE BIOMASS

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The objective of the study was to develop and characterize advanced cosmetic delivery systems incorporating hydrophilic and lipophilic extracts obtained from fruit and vegetable biomass, including celery, carrot, apple, and plum. The work focused on evaluating the impact of extract type and concentration on the physicochemical and biological properties of lipid nanocarriers, polymer gels, and hybrid formulations [1-3].

Lipid nanocarriers (LN: nanoemulsions, SLN, NLC) were prepared using hydrophobic plant-derived extracts as key lipid and hydrophilic plant-derived extracts as aqueous phase components. Their particle size, polydispersity index (PDI), and stability were analyzed. Polymer gels (hydrogels, oleogels, bigels) as well as hybrid systems (bigels-LN) containing the same extracts were formulated and evaluated in terms of morphology, rheological behavior, and stability. The biological properties of the formulations were also investigated, including collagenase inhibition capacity, antioxidant activity (DPPH assay), and metal ion chelating properties.

The type and concentration of the applied fruit and vegetable extracts significantly influenced the structural and functional properties of the systems. Lipid nanocarriers exhibited extract-dependent changes in particle size distribution and stability profiles. Polymer gels demonstrated notable variations in network morphology and rheological parameters, reflecting differences in extract composition. Hybrid systems showed enhanced stability and tunable textural properties, suggesting complementary interactions between lipid and polymer matrices. The incorporation of biomass-derived extracts into the developed formulations significantly increased their antioxidant, metal-chelating, and collagenase-inhibitory properties compared with the reference samples.

The obtained results highlight the potential of fruit and vegetable waste biomass as a sustainable source of bioactive ingredients for the development of advanced topical formulations, supporting circular economy principles and the Upcycled Beauty concept [1-3].

The work carried out within the framework of the project "Support for Students in Enhancing Their Competences and Skills", within the European Social Development Funds Programme 2021–2027, financed by the Ministry of Funds and Regional Policy of the Republic of Poland.

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Prof. Małgorzata Miastkowska is a University Professor at the Department of Chemistry and Organic Technology, Faculty of Chemical Engineering and Technology, Cracow University of Technology, where she has been employed since 2014. Her research focuses on the development of advanced formulation systems for pharmaceutical, cosmetic, and biomedical applications.

She is the co-author of 60 scientific publications, 15 patent applications, of which 11 have been granted, and several industrial implementations in the cosmetics sector. Her research integrates fundamental formulation science with practical industrial applications, contributing to the development of innovative products for healthcare and cosmetic technologies.

Her scientific interests include colloidal nanocarriers, liquid crystal systems, emulsions, hydrogels, emulgels, bigels, nanocarrier–hydrogel hybrid matrices, drug delivery systems, bioactive ingredient delivery, probiotic and enzyme carriers, biomaterials, pharmaceutical formulations, cosmetic technology, and medical devices. Through her research, she develops innovative carrier systems designed to improve the stability, efficacy, and controlled release of active compounds for pharmaceutical and cosmetic applications.

BIOLOGICAL EVALUATION OF HYDROGEL MATERIALS IN A 3D PSORIASIS MODEL: FROM CYTOTOXICITY TO MOLECULAR LANDSCAPE

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Psoriasis is a chronic, immune-mediated inflammatory skin disease affecting approximately 2–3% of the global population. It is characterized by excessive keratinocyte proliferation, abnormal differentiation, impaired epidermal barrier function, angiogenesis, and immune cell infiltration. Although topical therapies—such as corticosteroids and keratolytics—remain first-line treatments for mild to moderate cases, their effectiveness is often limited by poor skin penetration, rapid clearance, and local adverse effects. To overcome these challenges, advanced drug delivery systems are being actively explored. Equally important is the use of physiologically relevant cell models for accurate assessment of therapeutic efficacy.

In our recent studies, we used advanced 3D tissue psoriasis models that closely replicate the pathological and inflammatory features of the disease. These models display increased proliferation of basal cells, upregulation of psoriasis-specific markers, and increased cytokine secretion, offering a reliable and controlled platform for preclinical testing. Initially, the cytotoxicity of hydrogels loaded nanocarriers—salicylic acid and fluocinolone acetonide or hydrocortisone systems was assessed in a 3D model. Next, their therapeutic potential was verified by analyzing gene expression changes by qRT-PCR and quantifying proinflammatory cytokine levels by ELISA tests. The results confirm the potential of the tested hydrogels as an effective treatment for psoriasis.

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She is the co-author of 71 scientific publications (total impact factor over 343) and 16 Polish patents, with an H-index of 23. She is a recipient of the Ministry of Science and Higher Education Scholarship for Outstanding Young Scientists and has served as Principal Investigator of research projects funded by the National Science Centre (NCN). She actively collaborates in multidisciplinary research focused on innovative therapeutic strategies and biomaterials.

Her scientific interests include the anticancer activity of small-molecule compounds and nanomaterials, two-dimensional and three-dimensional cell models, molecular mechanisms of anticancer action, biological evaluation of hydrogels, biomaterials for cosmetic and medical applications, psoriasis treatment, and advanced in vitro models for the assessment of bioactive compounds.

PARAMETER-CONTROLLED ROTATING MAGNETIC FIELD AS A BIOPHYSICAL MODULATOR OF IN VITRO WOUND REPAIR

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Controlled wound repair depends on coordinated fibroblast activity, keratinocyte migration, redox balance and calcium signalling. Non-contact physical stimulation may support this process, but only if the biological response is defined by precise exposure parameters rather than by the field type alone. This in vitro study examined how a low-frequency rotating magnetic field (RMF) affects L929 fibroblasts and HaCaT keratinocytes. Cells in 24-well plates were exposed for 4 h to RMF at 30 or 50 Hz and magnetic induction values of 5.9, 13.6, 18.6, 22.8, and 28.4 mT. Metabolic activity and viability were assessed using CCK-8 and neutral red uptake assays; ROS, intracellular Ca2+ concentration, scratch wound closure and wound-healing-related gene expression were used as functional readouts. RMF induced cell-type- and parameter-dependent responses. At 30 Hz, HaCaT cells showed increased metabolic activity across the tested induction range, while L929 fibroblasts responded more selectively. Neutral red uptake changed only minimally, suggesting no marked loss of lysosomal viability. RMF altered ROS and Ca2+ levels, and these changes were associated with wound-closure dynamics. Less favourable keratinocyte responses were observed at 50 Hz under selected induction values, where weaker closure coincided with lower intracellular Ca2+ and altered ROS. Gene-expression data indicated modulation of extracellular-matrix and migration-related markers, including RAC1/CDC42-related pathways. Overall, 30 Hz RMF, particularly around 13.6-18.6 mT, gave the most balanced cellular profile. These findings may guide future studies combining RMF with polymer dressings or regenerative scaffolds, especially where controlled cell migration and redox signalling are required.

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He is the author and co-author of more than 360 scientific works, including over 136 publications indexed in Scopus, as well as more than 85 patents and patent applications. He has led and participated in numerous national and international research and development projects funded by the National Science Centre (NCN), the National Centre for Research and Development (NCBR), the Ministry of Education and Science (MEiN), the Operational Programme Smart Growth (POIR), and regional funding programmes. Many of these projects have been carried out in close collaboration with industrial partners, resulting in the development and implementation of innovative industrial technologies and process solutions.

His scientific interests include chemical and process engineering, process intensification, transport phenomena involving mass, momentum, and energy transfer, fluid mechanics, design of chemical and biochemical process equipment, industrial biotechnology, bioengineering, computational modelling, optimization of industrial processes, advanced materials, and technology transfer to industrial applications.

BACTERIAL CELLULOSE AS A BIOCOMPATIBLE PLATFORM FOR BACTERIOPHAGE-BASED SKIN INFECTION THERAPY

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Antimicrobial resistance is one of the most important global threats to public health. Therefore, for years there has been an intensive search for treatment methods that could be an alternative to traditional antibiotic therapy. Phage therapy is a leading candidate among the proposed solutions. There is also great interest in combining phages with various types of carriers to improve and expand their potential applications, e.g., as a dressing for difficult-to-heal wounds.

The presented research aimed to immobilize phages on bacterial cellulose (BC) and then analyze the effectiveness of the BC-based active dressing against bacteria forming biofilm.

In this study two phages were used against strains of methicillin-resistant Staphylococcus aureus (MRSA) and Pseudomonas aeruginosa that can form biofilm. To immobilize phages on BC-based carriers, adsorption method was used. For this purpose, a purified and sterile BC pellicle was incubated with phages in SM buffer. After incubation, the effectiveness of immobilization was analyzed. In order to analyze the effectiveness of BC-based dressing containing immobilized phages, the Antibiofilm Dressing's Activity Measurement (A.D.A.M. test) and an artificial wound bed model were used. Those tests allow checking in vitro a dressing's suitability against biofilm-related wound infections.

The results obtained in this study showed that BC is an ideal carrier for phage immobilization. The effectiveness of immobilization depended primarily on the properties of BC, such as crystallinity and porosity. Additionally, it was also confirmed that the created dressing is active against bacteria forming biofilm. The analysis showed that the degree of biofilm eradication depended on the type of phage and the number of particles immobilized on the carrier. In the case of S. aureus, a biofilm reduction of 35% was observed compared to the control (BC-based dressing without phage), and 42% in the case of P. aeruginosa.

These findings indicate that BC-based dressings containing immobilized phages may enhance future treatment of chronic, difficult-to-heal wounds, particularly those caused by antibiotic-resistant or biofilm-forming bacteria.

The work carried out within the framework of the project "The effect of free bacteriophages and those immobilized on a bacterial cellulose-based carrier on human cells and the possibility of their use in the treatment of wounds covered with biofilm" financed by the National Science Centre, grant number UMO-2023/51/D/NZ3/01853.

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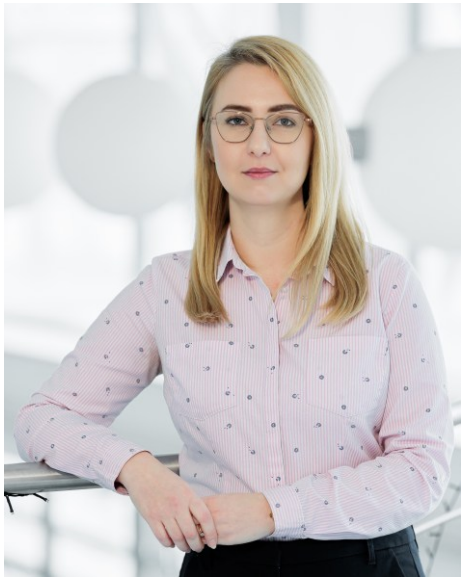

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Her research focuses on the biosynthesis, modification, and application of bacterial cellulose for biomedical and biotechnological applications. She investigates the use of bacterial cellulose as a functional carrier for the immobilization of bioactive compounds and microorganisms with high biotechnological potential, contributing to the development of innovative biomaterials.

Her current research is dedicated to the development of active wound dressings based on bacterial cellulose for the immobilization of bacteriophages to combat biofilm-associated infections. An important aspect of her work is the study of interactions between bacteriophages, bacterial cells, and human cells, with the aim of developing effective antimicrobial therapies and advanced wound-healing materials. Her scientific interests include bacterial cellulose, biomaterials, bacteriophages, biofilms, wound healing, microbial biotechnology, antimicrobial strategies, and biomedical applications of natural polymers.

BACTERIOPHAGES AS PRECISION ANTIMICROBIAL AGENTS FOR POLYMER-BASED WOUND HEALING SYSTEMS

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Infected and chronic wounds are complex microbial ecosystems in which bacterial pathogens persist despite antimicrobial treatment, host immune responses and repeated wound care procedures. A major factor responsible for therapeutic failure is the formation of mono- and polymicrobial biofilms, which protect bacteria from antibiotics, disinfectants and immune clearance. This is particularly relevant for wound-associated pathogens such as *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Escherichia coli*, *Klebsiella pneumoniae* and *Enterococcus faecalis*. The increasing frequency of multidrug-resistant isolates creates a clear need for antibacterial strategies that act beyond the classical antibiotic paradigm.

Bacteriophages are bacterial viruses that specifically recognize, infect and lyse bacterial cells. Their biological properties make them attractive candidates for wound infection control: high host specificity, activity against antibiotic-resistant strains, ability to replicate at the site of infection and potential to penetrate or destabilize bacterial biofilms. Unlike broad-spectrum antibiotics, phages can be selected against defined clinical isolates, allowing a personalized antimicrobial approach. This is especially important in chronic wounds, where the microbial composition may differ substantially between patients and may change during treatment.

The therapeutic potential of phages depends on careful biological characterization. Candidate phages for wound applications should be strictly lytic, genomically safe, free of known virulence or antibiotic resistance genes and active against clinically relevant bacterial strains. Key parameters include host range, efficiency of plating, adsorption rate, latent period, burst size, environmental stability and activity in biofilm models. Phage cocktails may further expand antibacterial coverage and reduce the risk of bacterial escape mutants. Importantly, the emergence of phage resistance does not necessarily indicate treatment failure, as resistance mechanisms may reduce bacterial fitness, virulence or biofilm-forming capacity.

Polymer-based wound healing systems provide an opportunity to translate phage biology into clinically useful materials. Hydrogels, nanofibrous membranes and polymeric coatings may protect phages from environmental inactivation, maintain local phage concentration and support controlled release directly at the wound surface. Such materials may also be designed to preserve phage infectivity while providing moisture balance, exudate absorption and compatibility with regenerating tissue. In this approach, the polymer is not the antimicrobial agent itself, but rather a functional delivery platform for biologically active phages. Bacteriophages incorporated into innovative polymer systems may represent a rational and highly adaptable strategy for infected wound management, especially in cases where conventional antimicrobials continue to lose effectiveness, because bacteria, tragically, remain better at adapting than most hospital procurement systems.

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His research combines experimental microbiology with genomic and molecular approaches to investigate phage–bacteria interactions and to explore the therapeutic potential of bacteriophages. Particular attention is devoted to the optimization of bacteriophage-based strategies for the treatment of biofilm-associated infections and to their potential application as alternatives or complements to conventional antimicrobial therapies.

His scientific interests include bacteriophage biology and therapy, bacterial biofilms, antimicrobial resistance, phage–bacteria interactions, microbial genomics, and the development of bacteriophage-based antimicrobial systems for biomedical applications. His current research contributes to the development of innovative approaches for controlling difficult-to-treat bacterial infections, including solutions with potential applications in advanced wound management and polymer-based wound healing systems.

MULTIFUNCTIONAL LUPEOL ESTERS FOR SKIN BARRIER REPAIR

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Damage to the skin barrier caused by environmental, chemical or mechanical stress requires active substances that can simultaneously limit oxidative injury and stimulate epidermal repair. Lupeol, a pentacyclic triterpene present in birch bark, exhibits antioxidant, anti-inflammatory and wound-healing activity; however, its high lipophilicity and limited water solubility restrict its bioavailability [1,2]. This study evaluated five novel lupeol esters—acetate, propionate, isonicotinate, succinate and acetylsalicylate—as multifunctional agents supporting skin barrier recovery. Antioxidant potential was assessed using DPPH, ABTS and FRAP assays and by determining the protection of albumin against chemically induced oxidative damage. The effects on human epidermal keratinocytes and dermal fibroblasts were examined using the WST-1 proliferation assay, time-lapse cell tracking, a scratch assay and fluorescence analysis of the actin cytoskeleton.

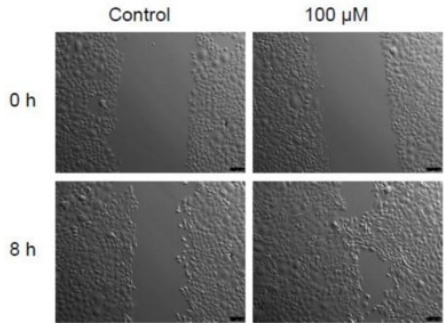

Figure 1. Representative scratch assay images of keratinocytes treated with 100 µM lupeol isonicotinate or vehicle control at 0 and 8 h. Scale bar = 100 µm.

All derivatives displayed stronger radical-scavenging activity than parent lupeol. Lupeol isonicotinate was the most effective compound, producing 27.66% DPPH inhibition, 29.96% ABTS inhibition and 0.59 FRAP units. The esters also markedly limited oxidative changes in albumin, and their protein-protective activity was comparable to that of glutathione. No cytotoxic effects were observed at the concentrations used in the cellular assays. After 24 h, lupeol acetate, lupeol isonicotinate and lupeol acetylsalicylate transiently increased keratinocyte proliferative activity to 133%, 143% and 131% of the untreated control, respectively, while fibroblast proliferation remained unchanged. Lupeol isonicotinate significantly increased keratinocyte speed, migration distance and displacement and accelerated wound closure in a concentration-dependent manner, with activity detectable from 0.1 µM. Microscopic observations showed enhanced organization of actin fibers in keratinocytes and fibroblasts, supporting a pro-migratory mechanism. The results identify lupeol isonicotinate as the most promising derivative and demonstrate that esterification can improve the multifunctional biological profile of lupeol. Novel lupeol esters may therefore be useful as active ingredients in advanced dermatological and cosmetic formulations designed to protect skin proteins against oxidative degradation and promote epidermal regeneration.

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Her research interests include natural product chemistry, cosmetic technology, biologically active plant extracts, biomimetic and transdermal drug delivery systems, skin protection and regeneration, functional biomaterials, and innovative delivery platforms for pharmaceutical and cosmetic applications.

RADIATION STABILITY OF POLYMERS USED IN 3D-PRINTED BOLUSES FOR MEGAVOLTAGE RADIOTHERAPY

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Boluses used in radiotherapy require stable and carefully selected materials to ensure accurate dose delivery and treatment reproducibility. The aim of this study was to investigate the effects of ionizing radiation (70 Gy, 6 MV) on the physicochemical properties of two materials commonly used for 3D printing radiotherapy boluses: acrylonitrile-butadiene-styrene copolymer (ABS) and thermoplastic copolyester (TPC). Surface roughness, tribological properties, hardness, dimensional stability, Fourier-transform infrared spectroscopy (FTIR), and differential scanning calorimetry (DSC) analyses were performed.

Following irradiation, minor changes in surface roughness parameters were observed for both materials, although ABS exhibited more pronounced surface degradation. Tribological testing revealed a 70% reduction in the coefficient of friction for ABS, whereas TPC remained stable. FTIR spectra indicated chemical changes associated with degradation and oxidation in ABS. In contrast, TPC showed only slight alterations in chemical stability and signs of potential cross-linking. DSC analysis demonstrated no significant thermal changes in TPC, while a decrease in the glass transition temperature of ABS suggested limited structural degradation. Irradiation also resulted in a slight increase in hardness for both materials, accompanied by minimal dimensional changes in ABS.

The obtained results indicate that therapeutic X-ray irradiation affects the investigated polymers in different ways. Although both materials retained their functionality after exposure to the therapeutic dose, TPC demonstrated superior chemical and mechanical stability. Combined with its greater flexibility, this characteristic may contribute to improved conformity to patient anatomy and enhanced reproducibility of dose distribution during radiotherapy.

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She actively conducts interdisciplinary research integrating physics, medicine, and materials engineering, with a particular emphasis on translational applications in healthcare. Her work contributes to the development of novel technologies supporting medical diagnostics, treatment planning, and personalized patient care.

Her scientific interests include medical physics, functional near-infrared spectroscopy (fNIRS), biomedical optics, three-dimensional (3D) printing technologies in medicine, medical imaging, personalized medical devices, radiation physics, and interdisciplinary biomedical engineering for healthcare applications.

STATISTICAL ANALYSIS OF DERMATOLOGICAL STATUS AND MEASUREMENTS ON NANOFIBER-BASED WOUND DRESSING MATS

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Statistical analysis of medical measurements is crucial for making evidence-based decisions in diagnostics or in choosing the right regime of therapy.

Pathological conditions can be identified reliably only if the characteristics of the healthy status are known. In order characterise healthy skin and provide reference data for later projects we performed a cross-sectional observational study on junior and senior volunteers from Hungary. The measured parameters were skin elasticity, transepidermal water loss, hydration (stratum corneum and epidermis), colour (erythema and melanin), and pH on face, hand, and forehead. Statistical analyses were used to compare junior and senior age groups, male and female participants and anatomical regions. The differences between the studied groups highlight the importance of considering age, gender, and anatomical regions in dermatological research and clinical evaluations, supporting the development of tailored cosmetic and skincare strategies.

Knowing the characteristics of compounds applied as wound dressing is needed for choosing the right materials. Moreover, the uncovering the relationship between the medically important features and manufacturing parameters can help the design of more optimised products. We electrospinned and tested different nanofiber-based wound dressing materials with key manufacturing parameters, including applied voltage, flow rate, spinning distance, and needle gauge. The relationships between the parameters were studied with their effects on the morphology, diameter, uniformity, porosity, mat thickness, and swelling of the produced nanofibers. The following statistical analysis gave us useful insights about the structure-property relationships of the fibers and the results can help the design of wound dressings with characteristics tailored for specific applications.

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He obtained his BSc degree in Molecular Bionics and his MSc degree in Medical Biotechnology before earning a PhD in Computational Biology in 2019. His interdisciplinary expertise enables the development and application of advanced computational methods for the analysis, modelling, and interpretation of complex biological systems.

His scientific interests include biostatistics, bioinformatics, computational biology, computational modelling of biological systems, biomedical data analysis, systems biology, medical biotechnology, and the application of data-driven approaches in biomedical and life science research. Through his research and academic activities, he contributes to interdisciplinary collaborations that bridge information technology, biotechnology, and medicine.

CHAMOMILE-MODIFIED BIOFUNCTIONAL POLYURETHANE FOAMS FOR WOUND CARE APPLICATIONS

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The skin is the largest organ in the human body, which, due to its complex multilayered structure, plays a key physiological role. At the same time it is continuously exposed to injuries caused by various factors, such as burns and mechanical damage. The repair of such defects involves a series of advanced and highly coordinated processes, which are particularly susceptible to impairment by inflammation and oxidative stress. Despite the skin's remarkable self-healing ability, the effectiveness of regeneration is largely determined by the selection of appropriate dressing materials that protect damaged tissue from secondary injuries and external contaminants [1]. Given the risk of infections caused by multidrug-resistant pathogens, it is essential to design wound dressings with significant antimicrobial activity. Furthermore, to reduce the excessive use of antibiotics, various additives, both inorganic and natural, rich in bioactive compounds, are used [2-3].

The design of wound dressings is focused on creating an appropriate microclimate at the site of injury. This helps maintain a balance between the biological mechanisms involved, thus supporting the skin regeneration process. Polyurethane is ideally suited for this type of dressing material. Its wide variety of forms and multifunctionality make this polymer one of the most extensively developed materials worldwide. Flexible polyurethane foam is particularly important in the design of dressing materials. It is characterized by biocompatibility with body tissues, non-cytotoxicity, and hydrolytic resistance, making it suitable for use in biomedical applications. Its high durability, softness, and elasticity enable precise adherence to the wound without exerting pressure on the damaged tissue and allow free movement without the risk of dressing displacement. Furthermore, due to its cellular structure, polyurethane foam exhibits appropriate gas and water vapor permeability and shows high exudate absorption capacity, thereby eliminating the risk of wound dehydration and weakening of the integrity of reconstructed tissues [4-5].

This study focused on the use of bioactive compounds of natural origin as modifiers for flexible polyurethane foam. The chamomile-derived compounds were shown to have a significant effect on the cellular structure of the prepared polymeric materials and contributed to their high microbiological purity. The release of trehalose from the polyurethane materials may contribute to improved moisturizing and protective effects on the skin. Moreover, the applied modifiers improved key functional properties, such as compression set and fluid sorption, making the designed flexible polyurethane foam-based materials attractive for wound dressing applications.

The work carried out within the framework of the 'PhDBoost' Program for doctoral students of the Doctoral School of Poznań University of Technology (in 2026) from the University's subsidy financed from the funds of Ministry of Science and Higher Education.

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Her scientific interests include polyurethane chemistry, polymer composites, biomaterials, drug delivery systems, transdermal drug delivery, polymeric carriers, advanced wound dressings, biomedical polymers, and the application of natural fillers in functional polymeric materials.

COMPARATIVE EFFECTS OF SELECTED BIOSTIMULATORY COMPONENTS ON WOUND CLOSURE AND MORPHOLOGY OF HUMAN DERMAL FIBROBLASTS

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Injectable biostimulatory preparations may support dermal regeneration through different cellular mechanisms, including stimulation of fibroblast proliferation, migration, extracellular matrix remodeling and changes in cell morphology [1,2,3]. However, their effects may differ not only in magnitude, but also in the dynamics and quality of the fibroblast response. Therefore, comparing the time course of wound closure together with cell morphology may provide a more informative assessment of their pro-regenerative potential than endpoint analysis alone.

Human dermal fibroblasts were treated with selected injectable biostimulatory formulations representing different classes of active components used in skin regenerative and aesthetic medicine, including calcium hydroxylapatite, recombinant human collagen combined, hyaluronic, carboxymethylcellulose, polynucleotides, and dimethylaminoethanol. The cellular response was assessed by evaluating cell viability and proliferation, together with an in vitro scratch wound healing assay. Wound closure dynamics were monitored over time, and fibroblast morphology was analyzed with particular attention to cell spreading, cytoplasmic extensions, monolayer organization and ECM-like remodeling.

The tested formulations differed in the rate and character of fibroblast response. Collagen-containing formulations showed the earliest and most pronounced effect on wound closure. This was accompanied by enhanced fibroblast spreading, improved cytoskeletal organization and formation of a compact, continuous monolayer with an ECM-like appearance, suggesting a response involving not only increased cell number, but also coordinated migration and matrix-associated organization. In contrast, calcium hydroxylapatite- and polynucleotide-based formulations also supported fibroblast viability and proliferation, but their effects on wound closure were slower or less morphologically organized.

The pro-regenerative activity of injectable biostimulatory components differs not only in intensity, but also in temporal dynamics and morphological pattern. Collagen-containing formulations appear to promote a faster and more organized fibroblast response, while other biostimulatory formulations may enhance fibroblast activity mainly through viability and proliferation. These findings indicate that time-dependent wound closure analysis combined with morphological assessment may better distinguish the regenerative profiles of injectable skin biostimulators than proliferation or viability assays alone.

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He is actively involved in the development of the Deep Skin project, contributing to interdisciplinary research that integrates medical expertise, clinical practice, and innovative technologies in skin health and aesthetic medicine. His work emphasizes the translation of scientific discoveries into evidence-based clinical applications aimed at improving patient care.

His scientific and clinical interests include regenerative medicine, orthopedics and traumatology, tissue regeneration, musculoskeletal disorders, skin regeneration, aesthetic medicine, translational medicine, and the development of innovative therapies for clinical practice.

DESIGN AND APPLICATION OF PHOTOPOLYMERIZED HYDROGEL SYSTEMS FOR TRANSDERMAL DRUG DELIVERY

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Transdermal drug delivery systems (TDDS) constitute a promising alternative to conventional oral administration due to their ability to bypass first-pass metabolism, improve bioavailability, and provide controlled release of active pharmaceutical ingredients (APIs). The present study focused on the synthesis and characterization of photopolymerized polymer gels designed for transdermal applications. Particular attention was devoted to the influence of polymer composition on adhesion, cohesion, mechanical stability, and drug release behavior.

Polymeric gels were synthesized via radical photopolymerization of methacrylate-based monomers under UV irradiation. Various formulations containing hydroxyethyl methacrylate (HEMA), polyethylene glycol derivatives, choline-based monomers, and auxiliary solvents were investigated. Selected systems were modified with ketoprofen and its choline derivative to evaluate the effect of API incorporation and salt formation on physicochemical and release properties. Adhesive performance was analyzed using a texture analyzer, while *in vitro* drug release studies were performed using UV–Vis spectroscopy.

The obtained results demonstrated that polymer composition significantly affected the final properties of the gels. Choline-containing monomers improved the compatibility and solubility of ketoprofen in polar media, while the incorporation of auxiliary monomers enabled tuning of adhesion and cohesion parameters. The synthesized materials exhibited favorable mechanical properties and controlled API release profiles, indicating their potential applicability as modern transdermal therapeutic systems.

The study confirms that photopolymerization is an efficient and versatile method for the preparation of transdermal polymer matrices with adjustable functional properties. The developed systems may provide a promising platform for future personalized and controlled drug delivery applications.

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BIOGRAPHY

Wiktoria Patz is a third-year PhD candidate at the Faculty of Chemical Technology, Poznan University of Technology, where she conducts her research in the Division of Polymeric Materials. Her doctoral research focuses on the development of biodegradable and environmentally friendly materials based on the choline cation for advanced technological and biomedical applications.

Her work combines principles of green chemistry, polymer science, and electrochemistry to design sustainable functional materials. She investigates the application of bio-based materials in electrochemical capacitors and transdermal drug delivery systems, contributing to the development of innovative technologies with reduced environmental impact.

Her scientific interests include polymeric materials, green chemistry, electrochemistry, sustainable materials, biomaterials, biodegradable polymers, choline-based materials, electrochemical energy storage, transdermal drug delivery, and environmentally friendly functional materials. Through her interdisciplinary research, she aims to develop innovative solutions that combine high performance with sustainability and environmental responsibility.

POSTER ABSTRACTS

STIMULUS-RESPONSIVE POLYURETHANE HYDROGELS FOR CONTROLLED LOCAL DELIVERY GEMCYTABINE AND DOCETAXEL FOR PANCREATIC CANCER THERAPY

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Pancreatic ductal adenocarcinoma remains one of the most lethal malignancies, largely due to late diagnosis, poor drug penetration into tumor tissue, and systemic toxicity of chemotherapeutic agents. Gemcytabine (GEM) and docetaxel (DOX) are widely used in pancreatic cancer therapy. However, their clinical effectiveness is limited by rapid clearance, low bioavailability, and severe systemic side effects. Therefore, the development of localized and high-controlled drug delivery systems capable of sustained GEM and DOX release is of significant interest.

In this study, stimulus-responsive polyurethane (PU) hydrogels were developed as implantable drug delivery systems for controlled release GEM and DOX. The hydrogels were synthesized using aliphatic and cycloaliphatic diisocyanates, copolymers of ε-caprolactone, rac-lactide, trimethylene carbotane and poly(ethylene glycol) (PEG), as well as PEG-block-poly(propylene glycol)-block-PEG, and other glycols. The copolymers were prepared via ring-opening polymerization of cyclic monomers employing a Zn-compounds and enzymes as catalysts. The resulting hydrogels were characterized in terms of swelling behavior, mechanical properties, cytocompatibility, hydrolytic degradation, and in vitro drugs release.

It was found that the obtained PU hydrogels exhibited high swelling capacity and mechanical parameters within the range typical for soft biological tissues, indicating their suitability for biomedical implantation. Cyto- and genotoxicity studies confirmed that the materials were non-toxic toward epithelial cells. Drugs release tests demonstrated sustained and controlled release of drugs over approximately 1-14 days at physiological pH 7.4 or 8.5. Kinetic profile analysis indicated that drug release followed predominantly near-zero-order kinetics and erosion- or diffusion-controlled mechanisms.

These results demonstrate that the developed stimulus-responsive PU hydrogels represent promising implantable carriers for localized and controlled delivery of GEM and DOX. Such systems may potentially enhance therapeutic efficacy while reducing systemic toxicity in the treatment of pancreatic cancer.

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PHOTOPOLYMER-BASED INNOVATIONS IN MEDICAL DRESSINGS: ADVANCED HYDROGELS AND ADHESIVE FILMS WITH ENHANCED MOISTURE VAPOR PERMEABILITY

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Photopolymerization technology has found widespread application in the biomedical field, particularly in the fabrication of wound dressings [1,2]. Photopolymers, i.e., light-sensitive materials that undergo polymerization upon exposure to UV or visible radiation, are finding increasingly broad applications in medical wound dressings, as well as in tissue engineering, dental composites, drug-eluting stents, ophthalmic lenses, and additive manufacturing of patient-specific implants. Photopolymers enable the fabrication of dressings with antibacterial, hemostatic, and wound-healing promoting properties. Owing to their versatility, biocompatibility, and adaptability to various clinical requirements, photopolymers offer substantial potential in the field of advanced wound care [3,4].

This work presents two types of photopolymers employed in the development of modern medical dressings. The first is a photopolymer based on poly(2-hydroxyethyl methacrylate) (pHEMA), used for the preparation of absorbent hydrogel dressings containing stinging nettle (*Urtica dioica*) extract. The second comprises copolymers of 2-hydroxyethyl methacrylate with butyl acrylate and other functional monomers, formulated as pressure-sensitive adhesive (PSA) binders designed to produce adhesives with enhanced water vapor transmission rate (WVTR).
It was demonstrated that hydrogels based on poly(2-hydroxyethyl methacrylate) solutions crosslinked with poly(ethylene glycol) diacrylate and incorporating nettle extract exhibit increased absorption capacity; however, this comes at the expense of deteriorated mechanical properties. Nevertheless, the successful incorporation of nettle extract into the hydrogel matrix suggests that such systems may potentially exert a wound-healing effect. Furthermore, photopolymerizable adhesive binders with significantly improved water vapor permeability were successfully synthesized. The addition of the hydrophilic monomer N-vinylpyrrolidone (NVP) was found to substantially accelerate the photopolymerization process and led to the formation of copolymers characterized by a broad molecular weight distribution and high weight-average molecular weight (Mw). This molecular architecture directly influenced the polymer network structure, resulting in a 54% increase in water vapor transmission rate relative to the minimum required value, while simultaneously maintaining favorable adhesion, tack, and cohesion properties, which are critical for medical-grade adhesive products.

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HYDROGEL FILMS BASED ON A STARCH DERIVATIVE AND POLY(ACRYLIC ACID) – PREPARATION AND EVALUATION OF PROPERTIES

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Hydrogels are materials with a three-dimensional polymer network capable of absorbing water in amounts several times exceeding their own weight [1]. In recent years, there has been a continuous increase in interest in hydrogels based on natural polymers (e.g., polysaccharides). This is due to their availability, biocompatibility, and more environmentally friendly nature compared to synthetic hydrogels.

In this study, a method for preparing a hydrogel based on a modified polysaccharide - hydroxypropyl starch (HPS, containing at least 50 wt.% of the polymer system), and poly(acrylic acid) (AA) was proposed. HPS is obtained through the etherification of starch with propylene oxide in an alkaline medium. Compared to native starch, HPS exhibits a higher degree of swelling in water and greater thermal stability [2].

The effects of reaction time, the ratio of starch derivative to acrylic acid, and the concentration of crosslinking agents on selected physicochemical properties of the obtained hydrogel films were investigated, including: swelling in water, water-soluble fraction content, moisture absorption capacity, thermal, mechanical, and rheological properties.

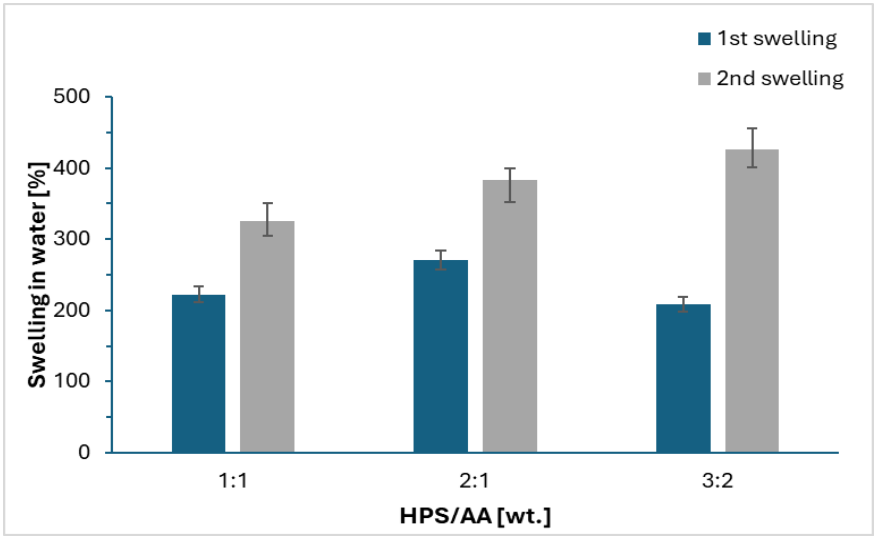

Figure 1. The effect of HPS/AA ratio on swelling in water of the obtained hydrogels

All obtained systems exhibited the ability to bind water. The highest swelling value in water (ca. 420%) was obtained for the system prepared at an HPS:acrylic acid weight ratio of 3:2. Increasing the crosslinking density resulted in improved mechanical properties of the obtained films.

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PRO-REGENERATIVE POTENTIAL OF HERICIUM ERINACEUS ALCOHOLIC EXTRACT IN HUMAN DERMAL FIBROBLASTS

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Hericium erinaceus has well-documented bioactive properties. Its constituents including polysaccharides and polypeptides, terpenoids and polyketides, as well as erinacines and hericenones, exhibit antioxidant, immunomodulatory, and anti-inflammatory activities. The biological properties of *H. erinaceus* have been studied mainly in the context of neuroprotection and neuroregeneration [1]. However, *H. erinaceus* extract may also improve the function of other cell types.

Aqueous extracts of *H. erinaceus*, rich in polysaccharides, glycoproteins, and antioxidants, have been shown to increase type I procollagen production and reduce MMP-1 and elastase-1 activity in UV-damaged fibroblasts [2]. In skin cells from patients with reduced levels of frataxin, a protein involved in iron–sulfur cluster biogenesis, *H. erinaceus* extract decreased oxidative damage and reduced apoptosis [3].

In contrast, there are relatively few reports on alcoholic extracts of *Hericium*, which contain unique secondary metabolites. Therefore, we investigated the pro-regenerative potential of an alcoholic extract of *H. erinaceus* using human dermal fibroblasts (HDFs), based on cell viability, proliferation, and the rate of wound closure.

Treatment with the extract increased fibroblast viability and proliferation in a dose-dependent manner. This effect was also reflected in the wound healing assay, where stimulation with *H. erinaceus* extract accelerated closure of the damaged area in the cell monolayer.

The active compounds present in the *H. erinaceus* extract may therefore enhance fibroblast migration toward the injured area and support their regenerative functions, most likely through modulation of extracellular matrix production and remodeling.

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KALANCHOE PINNATA (LAM.) PRES. EXTRACTS FOR COLLAGENASE INHIBITION

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Kalanchoe pinnata (Lam.) Pres. (Figure 1), is a succulent belonging to the Crassulaceae family. It grows wild in tropical and subtropical regions. In Europe it can be found as a potted plant. Large amount of polyphenolic compounds determines that the plant's water and ethanol extracts are used in different skin disorders as antibacterial and antifungal [1].

The skin is considered as the biggest organ in human body. It is the first, external barrier for organism that the function is strictly related with the composition. Collagen is one of the main macromolecules of the skin, responsible for its structure. Degradation of collagen fibers by collagenase enzyme is an unvented, yet natural ageing process, leading to sagging and wrinkles formation. Natural and safe inhibitors of collagenase are still demanded.

Methods: Water and ethanol extracts from *Kalanchoe pinnata* were fractionated into water and dichloromethane fractions. Resulted fractions were tested spectrophotometrically for their ability to inhibit the collagenase enzyme. Briefly: each fraction was incubated in tricine buffer with collagenase. After 10 minutes substrate (FALGPA) was added. The changes in velocity of the enzyme-substrate reaction were observed and calculated with the GraphPad Prism 9 program.

Results: The analysis reviled the ability to inhibit collagenase enzyme dose-dependently by all fractions from *Kalanchoe pinnata* extracts. Calculated IC_{50} values of the aqueous fraction from ethanol extract was comparable to the IC_{50} of the standard substance oleanolic acid (IC_{50} = 23.34 ± 1.5 and 21.75 ± 1.22 µg/mL, respectively).

Discussion: aqueous fraction of the ethanol extract from *Kalanchoe pinnata* could be used as protection against collagen degradation especially in anti-aging skin care products.).

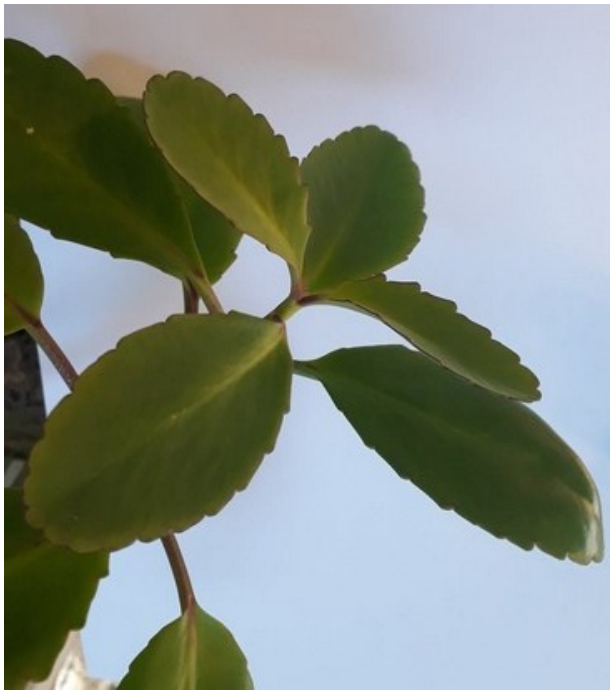

Figure 1. *Kalanchoe pinnata* (Lam.) Pres.

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SELECTIVE MODULATION OF SKIN MICROBIOTA USING A TOPICAL ENCAPSULATED PROBIOTIC SYSTEM

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Skin microbiome imbalance (dysbiosis) is associated with numerous dermatological disorders and impaired skin barrier function. Therefore, the development of microbiome-friendly topical formulations has gained increasing attention as a strategy for restoring microbial balance and supporting skin health.

The aim of this study was to develop and evaluate a novel dermocosmetic formulation containing *Lactobacillus casei* ATCC 393 encapsulated in alginate–tapioca microspheres coated with hyaluronic acid. The encapsulation approach was designed to improve probiotic stability and enable its effective incorporation into a topical formulation.

The probiotic strain demonstrated selective antimicrobial activity, significantly reducing the viability of Staphylococcus aureus, while not inhibiting the commensal Staphylococcus epidermidis, which plays an important role in maintaining skin microbiome balance. The developed formulation exhibited good physicochemical stability and ensured high viability of encapsulated bacteria. In vitro studies performed on human keratinocytes (HaCaT) and fibroblasts (HSF) confirmed low cytotoxicity. The formulation also showed pro-regenerative potential in a scratch assay model, enhancing wound closure at lower concentrations. Moreover, it inhibited the growth of pathogenic microorganisms, including S. *aureus, Escherichia coli, Candida albicans,* and *Cryptococcus neoformans*, while not adversely affecting commensal strains.

These results indicate that the developed formulation represents a promising microbiome-friendly approach for dermatological applications.

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HYBRID POLYMER–LIPID NANOCARRIERS FOR ENHANCED DELIVERY OF HORSE CHESTNUT EXTRACT IN WOUND HEALING AND ANTI-EDEMA APPLICATIONS

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Skin edema and impaired microcirculation are common clinical challenges associated with inflammation, vascular dysfunction, and delayed tissue regeneration, including wound healing processes. Natural bioactives such as horse chestnut (Aesculus hippocastanum) seed extract, rich in escin, exhibit anti-inflammatory, anti-edematous, and vasoprotective properties; however, their therapeutic efficacy is often limited by insufficient skin penetration and instability in conventional formulations [1,2].

This study aimed to develop and characterize innovative nanoscale carrier systems for the effective delivery of horse chestnut extract, with potential applications in wound healing and related biomedical fields. Nanoemulsions and nanostructured lipid carriers (NLCs) were prepared using ultrasonic homogenization and subsequently incorporated into a hyaluronic acid (HA)-based polymeric gel matrix to form hybrid systems (nanoemulgels and HA–NLC systems). A propanediol–glycerol–water system enabled efficient solubilization of the extract (3.5% w/w), overcoming limitations observed with conventional solvents.

The obtained formulations were evaluated in terms of physicochemical stability, particle size distribution, polydispersity index (PDI), rheological behavior, and user-relevant properties. Dynamic light scattering analysis confirmed nanoscale dimensions (<200 nm) with low PDI values (<0.25), indicating high homogeneity. The systems demonstrated excellent stability under varying temperature conditions and centrifugation tests. Rheological analysis revealed pseudoplastic behavior, favorable for topical application. Incorporation into the HA matrix significantly improved viscosity, spreadability, and retention on the skin surface, while maintaining desirable release characteristics.

The developed hybrid nanocarrier systems exhibited enhanced functional performance compared to a commercial reference product, particularly in terms of application properties and perceived efficacy. These findings highlight the potential of polymer–lipid nanostructured carriers as advanced platforms for delivering plant-derived bioactives in wound healing and other biomedical applications, enabling improved bioavailability and targeted action at reduced active compound concentrations.

PLANTS AS A PROMISING STRATEGY FOR TISSUE REPAIR: INSIGHTS FROM *SANGUISORBA OFFICINALIS* L.

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Introduction: Modern pharmacology increasingly utilizes plant materials that demonstrate potential for wound healing and the regeneration of damaged skin tissue. One such plant with a well-established position in traditional medicine is *Sanguisorba officinalis* L., also known as great burnet. Traditionally, the root of this plant was used to stop bleeding, alleviate inflammation, and accelerate skin regeneration, but research indicates that its aerial parts are also a valuable source of health-promoting compounds.
Objective: The aim of this study was to evaluate the antioxidant and antibacterial activity of ethanol extracts from the herb *S. officinalis* and to analyze the phenolic acid content, along with an assessment of their ability to permeate and accumulate in the porcine skin.
Methodology: Extracts were prepared using 40% and 70% ethanol, followed by HPLC analysis of the qualitative and quantitative composition of phenolic acids. Ex vivo skin permeation studies were conducted using Franz diffusion cells.
Results: HPLC analysis identified seven phenolic acids in the great burnet extract. The highest concentrations were recorded for gallic acid (424 ± 10 mg/L) and vanillic acid (270 ± 5 mg/L). The extracts demonstrated significant antioxidant activity (up to 84.54 g Trolox/L) and a broad spectrum of antibacterial activity against Gram-positive and Gram-negative strains, particularly *P. aeruginosa* (inhibition zone up to 23.7 mm) and *S. pneumoniae*. The permeation study demonstrated that vanillic acid penetrated the acceptor fluid at the highest concentration (10 ± 1 µg). From the perspective of local therapeutic action, the ability of compounds to accumulate in tissue is crucial: the highest accumulation in the skin was observed for 2,5-DHBA (53 ± 4 µg/g), 2,3-DHBA (45 ± 3 µg/g), and gallic acid (45 ± 3 µg/g).
Conclusions: The herb *Sanguisorba officinalis* is a rich source of phenolic acids with strong antioxidant activity and antibacterial potential. The ability of these metabolites to penetrate and accumulate in the superficial layers of the skin suggests that extracts from this plant may be an effective ingredient in modern preparations supporting the treatment of inflammation and skin repair processes.

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SODIUM ALGINATE/HYDROXYAPATITE COMPOSITE HYDROGELS PREPARED WITH ADDITIVE MANUFACTURE

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Natural polymer-based hydrogels have emerged as promising biomaterials for a wide range of biomedical applications owing to their excellent biocompatibility and tunable physicochemical properties. Their potential applications include tissue engineering, bone defect repair, wound healing, and controlled drug delivery. Among natural biopolymers, sodium alginate is particularly attractive due to its availability, mild gelation conditions, and suitability for the fabrication of composite hydrogels containing bioactive inorganic phases.

Calcium phosphates are widely used as such additives because of their favorable biological response and osteoconductive properties. Hydroxyapatite has attracted considerable interest as its performance can be tailored through control of its crystallinity and particle characteristics.

The present study aimed to synthesize nanosized hydroxyapatite powders with varying degree of crystallinity and incorporate them into sodium alginate to fabricate sodium alginate/hydroxyapatite composites using extrusion-based additive manufacturing (3D printing).

The obtained hydroxyapatite nanopowders were characterized using X-ray powder diffraction (XRD), Fourier-transform infrared spectroscopy (FT-IR), energy dispersive spectroscopy (EDS) and transmission electron microscopy (TEM) and other physicochemical techniques. Preliminary *in vitro* evaluation was performed to assess the cytotoxicity of the synthesized hydroxyapatites and their influence on the morphology of osteoblast-like cells.

The additive manufactured sodium alginate/hydroxyapatite hydrogel composites were comprehensively characterized using a wide range of physicochemical techniques, particularly XRD, FT-IR, thermogravimetric analysis (TGA), differential scanning calorimetry (DSC), as well as by evaluating their swelling degree and mechanical properties.

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WILD STRAWBERRY (*FRAGARIA VESCA L.*) EXTRACT AS AN INNOVATIVE INGREDIENT OF POLYMER DRESSINGS SUPPORTING WOUND HEALING

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Chronic oxidative stress impairs proper wound healing; therefore, antioxidant compounds are increasingly used as active components of polymeric wound dressings [1]. Wild strawberry (*Fragaria vesca* L.) leaves show documented anti-inflammatory properties [2], and polyphenolic extracts exhibit wound-healing potential, confirmed in vitro on skin fibroblasts [3]. An extract from *F. vesca* leaves has already been used as an ingredient of an antioxidant hydrogel [4]. The aim of this study was to obtain and characterize a glycerin extract from wild strawberry leaves in terms of its antioxidant activity and phytochemical profile, in order to assess its potential as an ingredient of polymeric wound dressings.

Extracts from *F. vesca* leaves were obtained by ultrasound-assisted extraction (40 kHz), using distilled water and glycerin solutions (5–25% w/v) at extraction times of 15, 30 and 60 minutes (18 variants). Antioxidant activity was assessed by the DPPH and Folin–Ciocalteu (TPC) methods, with results expressed as trolox equivalents (RT, mg TE/g raw material). The extract with the highest activity was analysed by HPLC and GC-MS.

The highest antioxidant activity was shown by the extract obtained after 60 minutes in a 15% glycerin solution (DPPH: 162.9 mg TE/g; TPC: 117.6 mg TE/g), whereas the values for all 18 variants ranged from 87.5–162.9 mg TE/g and 52.9–117.6 mg TE/g, respectively. This extract was selected for further characterization by HPLC and GC-MS.

Among the eight phenolic compounds identified by HPLC, those with documented wound-healing activity were highlighted: kaempferol- accelerates wound epithelialization [5]; ellagic acid- stimulates collagen synthesis [6]; quercetin- enhances fibroblast migration [7].

Similarly, among the volatile metabolites identified by GC-MS, compounds with confirmed wound-healing-supporting activity were selected: neophytadiene- anti-inflammatory [8]; phytol- anti-inflammatory and antioxidant [9]; γ-sitosterol- anti-inflammatory [10].

The glycerin extract from wild strawberry leaves shows high antioxidant activity and a rich profile of wound-healing-promoting compounds, indicating its potential as an ingredient of polymeric wound dressings supporting wound healing and justifying further research into its incorporation into a polymeric matrix.

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ANTIOXIDANT FILM BASED ON BIOPOLYMER AND BIOACTIVE PIGMENT AS A PROMISING COMBINATION FOR WOUND HEALING APPLICATIONS

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Chitosan, due to its biological and physicochemical properties, has been widely investigated for advanced materials development, such as novel wound dressings or regenerative materials for tissue engineering. Availability, biocompatibility, nontoxicity, biodegradability, low immunogenicity, as well as antioxidant, antimicrobial, hemostatic activity, and wound healing properties of chitosan make it an important biomaterial component [1]. Biologically active compounds can increase the therapeutic potential of chitosan-based wound healing materials and enhance skin regeneration. Alizarin, a natural molecule extracted from the roots of the tinctorial plant madder (*Rubia tinctorum*), is characterized by antioxidant and antimicrobial activity, as well as UV barrier properties [2]. Recently, alizarin has been investigated as a real-time pH-responsive indicator. Modern wound dressings with a colorimetric pH sensor can provide proper wound management and monitoring of pH values related to bacterial infections. The aim of the study was to obtain and characterize chitosan films enriched with alizarin. Physicochemical characterization and biological assessment were performed. For prepared structures, mechanical properties, moisture vapour transmission rate, and swelling degree were evaluated. Surface properties of chitosan/alizarin films, such as roughness and wettability, were examined by atomic force microscopy and contact angle measurements, respectively. Surface free energy was calculated. Color sensitivity to pH change was evaluated by colorimetric measurements. Antioxidant activity of samples was determined by ABTS radical scavenging assays. Whole blood clotting and cytotoxicity tests were also performed. As results have shown, the incorporation of alizarin contributed to increased surface roughness and rendered the surface hydrophilic. Mechanical reinforcement of samples was observed, thus, this bioactive pigment addition increased the film's tensile strength and flexibility, as well as decreased the swelling degree and moisture vapour transmission rate. Moreover, chitosan/alizarin films underwent an easily visible color transition in response to pH variations, which was also confirmed by the delta E value. Chitosan materials enriched with alizarin were non-cytotoxic to L929 fibroblasts and stimulated their proliferation. They were also characterized by antioxidant activity, and on their surface more clot formation was observed. Hence, these materials can be considered for further advanced studies. Alizarin and chitosan might be a promising combination for the development of multifunctional biomaterials for wound healing applications.

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BIOPOLYMERIC-BASED POROUS MATERIALS WITH ANTIOXIDANT PROPERTIES AS A POTENTIAL WOUND DRESSINGS

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Wound healing is a complex process consisting of several well-coordinated stages, including hemostasis, an inflammatory response, proliferation, and remodeling [1]. The materials used in modern wound dressings should support the healing process across its various phases and exhibit a wide range of beneficial properties. These include biocompatibility, biodegradability, and antioxidant and/or antibacterial activity. The antioxidant potential of dressing materials has been demonstrated to maintain a balanced wound environment, thereby preventing excessive activity of reactive oxygen species (ROS). It has been shown that the strong oxidizing properties of ROS can damage the cells' structure, intensify the inflammatory response, and disrupt the healing process [2].

In this study, the focus was on the design of polymeric porous structures enriched with two natural antioxidants: resveratrol and syringic acid. The structural basis of the materials was a blend of chitosan and konjac glucomannan, biopolymers that belong to the polysaccharides. Chitosan is derived from chitin, the second most abundant polymer in nature after cellulose [3]. Konjac glucomannan is obtained from the tubers of Amorphophallus konjac [3]. Both polymers have gained popularity in recent decades, and thanks to their beneficial properties, are particularly used in wound dressings, drug delivery carriers, scaffolds, and implant coatings.

The biopolymeric materials were fabricated via the freeze-drying procedure and characterized by the following methods: scanning electron microscopy (SEM), swelling analysis, antioxidant assay, and cytotoxicity tests on appropriate skin cell lines. The results indicated the influence of antioxidant low-molecular additives on the material's structure (Fig.1). Furthermore, they suggest an advantageous profile of properties for use in dressings.

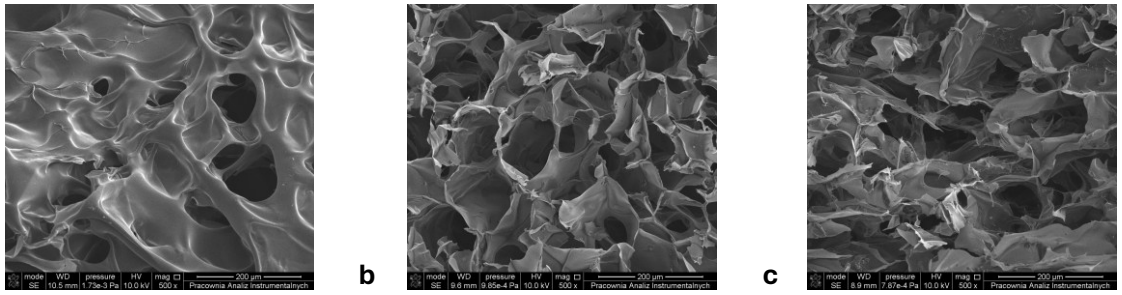

Figure 1. SEM images of pristine polymeric material (a) and materials containing varying concentrations of resveratrol and syringic acid (b,c).

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INJECTABLE AMPHIPHILIC POLYMER NANOPARTICLES LOADED WITH QUERCETIN FOR INTRA-ARTICULAR OSTEOARTHRITIS TREATMENT

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The most common musculoskeletal disease connected with articular cartilage defects is osteoarthritis (OA). It is estimated that OA affects about 40 million citizens in Europe and 240 million people worldwide. Despite the development of nanomedicine, current treatments are limited to managing disease progress and eliminating pain [1]. Therefore, there is a pressing need to develop effective, long-term drug delivery systems (DDSs) containing OA drugs for intra-articular (IA) administration to improve the health of OA patients. DDSs can provide controlled and sustained drug release, enabling long-term treatment (*in vivo* stability) and thus reducing the number of injections [2]. The need for such systems has led to this study on the development of new drug delivery systems with controlled release rates using a precise macromolecular engineering approach and applying these nanocarriers to the treatment of OA [3].

In this study, controlled radical polymerization methods (reversible addition-fragmentation chain transfer and ring-opening polymerization) were used to design nanocarriers. Amphiphilic block copolymers (APCs) comprising poly(ethylene glycol) and poly(lactic-co-glycolic acid) were developed as hydrophilic and hydrophobic blocks, respectively. The obtained APCs were characterized by nuclear magnetic resonance (NMR) spectroscopy and Fourier-transform infrared (FTIR) spectroscopy. Quercetin (QE), a natural-based bioactive phytocompound (BAPC) with known anti-inflammatory and pain-reducing effects, was loaded into amphiphilic polymer nanoparticles (APNPs) via a water-in-oil-in-water (W/O/W) double emulsion method. The size of the obtained QE-loaded APNPs was evaluated by the dynamic light scattering (DLS) method. In order to evaluate the safety of the formulation, *in vitro* biocompatibility was determined via MTT assay against mouse fibroblasts and chondrocytes.

The research findings indicate that these engineered amphiphilic block copolymers could act as nanocarriers for localized osteoarthritis therapy. By loading anti-inflammatory QE into these APNPs, a biocompatible system capable of controlled intra-articular drug release was achieved. This strategy may offer a practical approach to overcome the short-acting limitations of current joint injections, potentially supporting the development of long-term therapies for chronic pain management and cartilage preservation.

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PILOT EVALUATION OF AN EPILOBIUM ANGUSTIFOLIUM L. EXTRACT-CONTAINING TOPICAL HYDROGEL ON SKIN BIOPHYSICAL PARAMETERS IN HEALTHY VOLUNTEERS

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Plant-derived extracts are increasingly investigated as multifunctional ingredients in cosmetic and dermocosmetic formulations [1]. *Epilobium angustifolium* L. has been described as a promising herbal component due to its antioxidant, anti-inflammatory, antimicrobial and anti-aging potential [2,3]; however, the effects of finished topical formulations on human skin parameters require objective evaluation. This pilot study aimed to assess the short-term effects of a developing *Epilobium angustifolium* extract-containing hydrogel on skin biophysical parameters in healthy volunteers. Ten healthy volunteers were included. A vehicle hydrogel and an extract-containing hydrogel were applied to two separated areas on the inner surface of the left forearm. Skin measurements were performed at baseline and after a 1-hour exposure period without removing the products before post-treatment assessment. Surface hydration, deeper epidermal hydration, transepidermal water loss, elasticity, erythema index and melanin index were measured in triplicate using non-invasive accredited skin diagnostic devices. Both hydrogels significantly increased surface and deeper epidermal hydration and significantly reduced transepidermal water loss after 1 hour, while no significant change was observed in elasticity. A greater increase in erythema and melanin indices was observed after application of the extract-containing hydrogel compared with the vehicle, although these findings should be interpreted with caution because the remaining or dried product layer may have influenced the optical measurements. Overall, the study demonstrated that the applied protocol and diagnostic devices are suitable for monitoring short-term effects of topical cosmetic formulations. The *Epilobium angustifolium* extract-containing hydrogel may represent a promising development direction, but further studies with a larger sample size, randomized application sites, standardized product removal and additional tolerability assessment are needed to clarify extract-specific effects.

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SUSTAINED DRUG DELIVERY CARRIERS FOR INTRA-ARTICULAR ADMINISTRATION

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Articular cartilage is an avascular and aneural tissue with a limited intrinsic capacity for regeneration. Due to the absence of blood vessels, nutrients are supplied to chondrocytes primarily through diffusion from the synovial fluid across the extracellular matrix (ECM) [1]. Osteoarthritis (OA), the most common degenerative joint disease, is characterized by progressive cartilage degradation, chronic inflammation, pain, and loss of joint function, representing one of the leading causes of disability worldwide [2]. Intra-articular (IA) administration offers a targeted strategy for delivering therapeutic agents directly to the joint cavity, enabling high local drug concentrations while reducing systemic exposure and associated adverse effects. Conventional IA formulations are rapidly cleared from the synovial cavity through lymphatic drainage and joint fluid turnover, resulting in limited residence time and short-lived therapeutic efficacy [3]. To overcome these limitations, considerable research efforts have focused on the development of long-acting intra-articular drug delivery systems, including hydrogels, microparticles, nanoparticles, liposomes, and other injectable carrier platforms capable of sustaining drug release and prolonging retention within the joint environment [4].

In this study, amphiphilic polymer nanoparticles (APNPs) were synthesized using commercially available hydrophobic poly(lactic acid) (PLA) chains of varying molecular weights and hydrophilic poly(ethylene glycol) (PEG) segments. The resulting nanoparticles, with diameters ranging from 30 to 80 nm, were comprehensively characterized using spectroscopic techniques to confirm their chemical structure and composition, as well as microscopic methods to evaluate their morphology and size distribution. The APNPs were subsequently successfully loaded with lornoxicam (Lnx), a nonsteroidal anti-inflammatory drug (NSAID) of the oxicam class exhibiting anti-inflammatory and analgesic properties with potential chondroprotective effects, and berberine (Ber), an isoquinoline alkaloid originally isolated from Rhizoma Coptidis, which possesses a broad spectrum of pharmacological activities, including anti-inflammatory and anti-apoptotic effects.

Given their potential application as long-acting intra-articular drug delivery systems, these novel APNP-based carriers may provide sustained therapeutic effects and contribute to improved long-term pain management in osteoarthritis. Therefore, the strategy presented in this study may help address key limitations of currently available OA treatments and support the development of more effective therapies for chronic pain relief and cartilage preservation.

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THANK YOU

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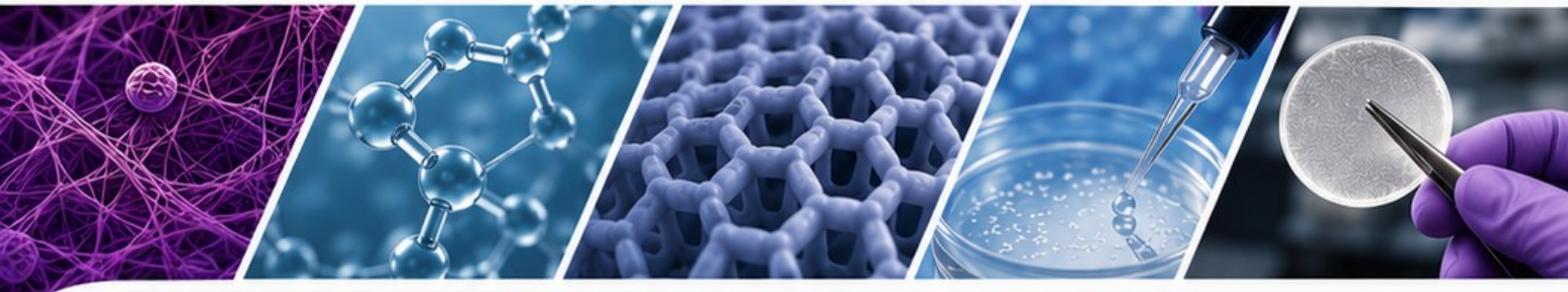

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