Abstract Book

1st International Student Conference on Industrial Pharmacy

ISPE

Student Chapter of International Society
for Pharmaceutical Engineering at PUMS

POZNAN UNIVERSITY OF MEDICAL SCIENCES

POLAND

1st International Student Conference on Industrial Pharmacy

7th -8th December 2023
Poznań, Poland

ISBN 978-83-7597-465-2

Conference Internet Service

Website:
https://ispe.ump.edu.pl/

Facebook:
1st International Conference on Industrial Pharmacy (ISPE Poznań)

Instagram:
https://www.instagram.com/ispepoznan/

Contact

Poznań Student Chapter ISPE
Karolek Dormitory
5E Rokietnicka Street,
60-806 Poznań
ispepoznan@gmail.com

Poznań Student Chapter ISPE is not responsible for the content of abstracts available in this abstract book.

HONORARY PATRONAGES

Rector of Poznan University of Medical Sciences
Prof. Andrzej Tykarski, M.D., Ph.D.

Dean of the Faculty of Pharmacy of
Poznan University of Medical Sciences
Prof. Anna Jelińska, MPharm., Ph.D.

Greater Poland Regional Pharmacy Chamber

Polish Pharmaceutical Students' Association

Students' Scientific Society PUMS

POLISH PHARMACEUTICAL
STUDENTS' ASSOCIATION

SPONSORS

BIOFARM®

ABL&E-JASCO POLSKA

shim-pol®

exclusive distributor of

SHIMADZU
Excellence in Science

GENERICA
LABORATORIUM
FARMACEUTYCZNE

MEDIA PATRONAGE

TVP 3 POZNAŃ

Farmacja Wielkopolska

Radio Poznań

PULS GAZETA STUDENTÓW

ORGANIZING COMITTEE

Chair: Antoni Białek
Dr Irena Budnik
Dr Barbara Jadach
MPharm Michał Gackowski
MPharm Piotr Gadziński
Msc Oliwia Kordyl
MPharm Monika Wojtyłko
Julia Krysztofiak
Maciej Michalak
Maria Wołoszczuk
Jakub Wujec

SCIENTIFIC COMITTEE

Chair: Assoc. Prof. Tomasz Osmałek
Prof. Judyta Cielecka-Piontek
Prof. Anna Jelińska
Prof. Violetta Krajka-Kuźniak
Prof. Janina Lulek
Prof. Jan Matysiak
Dr habil. Grzegorz Garbacz
Dr Arkadiusz Hejduk
MSc Jarosław Pieczuro
Assoc. Prof. Dorota Danielak
Assoc. Prof. Jacek Kujawski
Assoc. Prof. Jarosław Paluszczak
Assoc. Prof. Paulina Skupin-Mrugalska

VOLUNTEERS:

Natalia Wojtek Julia Tuszyńska Julia Fabiś
Jakub Szymczyk Oskar Hoffmann

PROGRAMME

THURSDAY 7.12

10.30-11.30	Registration
11.30-11.45	Opening
11.45-12.15	Lecture - Prof. Janina Lulek
12.15-13.00	Lecture - Prof. Dimitrios A. Lamprou
13.00-13.30	Lecture - Dr Pawel Stasiak
13.30-14.00	Coffee break
14.00-14.30	Lecture - Dr Gábor Vasvári
14.30-15.15	Sponsors' lectures
15.15-15.45	Lecture - Prof. Tomasz Osmałek
15.45-16.45	Lunch
16.45-19.00	Practical demonstrations

FRIDAY 8.12

9.00-9.30	Registration
9.30-10.15	Lecture - Prof. Małgorzata Sznitowska
10.15-11.00	Lecture - Prof. Sebastian Polak
11.00-11.30	Coffee break
11.30-12.15	Lecture - Dr Valentyn Mohylyuk
12.15-13.15	Poster session
13.15-14.35	Presentation of awarded abstracts
14.35-15.00	Closing remarks
15.00-16.00	Lunch
20.00-2:00	Social event



ISPE

Student Chapter of International Society
for Pharmaceutical Engineering at PUMS

STUDENTS' SESSION

3D spheroids cancer models to study activation of cGAS-STlNG pathway by 2'3'cGAMP agonist.

Authors: Natalia Guźniczak, Katarzyna Kaczmarek, Marek Giers, Marcel Mohr, Daria Szczepaniak
Affiliation: "1. Department of Cancer Immunology, Poznan University of Medical Sciences, 61-866 Poznan, Poland.
2. Department of Diagnostics and Cancer Immunology, Greater Poland Cancer Centre, 61-866 Poznan, Poland."
Tutor: Prof. dr hab. Hanna Dams-Kozłowska

Introduction: The cGAS-STING pathway is responsible for microbial and host-derived DNAs sensing in the cytoplasm. The activation of cGAS-STING induces the production of type I interferons, which plays significant role in innate and adaptive immune response. Moreover, it can induce the apoptosis of cancer cells. The 3D cell culture systems show potential for better simulating the in vivo tumor microenvironment.

The aim of the study: Generation of 3D spheroidal tumor models for analysis of 2'3'cGAMP activity in the cGAS-STlNG pathway.

Methods: SKOV3, SKBR3, MDA-MB-231, and MCF7 cells were cultured in 2D and 3D conditions. For 2D study SKOV3 and SKBR3 were seeded in a quantity of 5000 cells/well, while MDA-MB-231 cells 10000 cells/well and MCF7 cells 4000 cells/well. For 3D conditions SKOV3, SKBR3, and MDA-MB-231 were seeded in a quantity of 10000 cells/well on a 96-well plate, while MCF7 cells 5000 cells/well. The 2'3'cGAMP agonist was delivered to the cells using Lipofectamine RNAiMAX. The activity of 2'3'cGAMP was monitored by analysis of cells apoptosis using CellEvent™ Caspase-3/7 Assay. The fluorescent signal was observed using Leica Microscope after 2, 4, and 30 hours.

Results: The method for generation of a 3D spheroid cancer models for study cGAS-STlNG pathway activation was optimized. In response to 2'3'cGAMP the apoptosis of cancer cells was observed in 2D- and 3D-culture conditions. The 2D conditions enabled the observation of apoptosis of all tested cells after agonist stimulation, while the implementation of 3D culture conditions confirmed the apoptosis in SKOV3, MDA-MB-231 and MCF7 cells.

Conclusions: The effect of 2'3'cGAMP stimulation observed in 2D- and 3D-cell cultures was different indicating the validity of using 3D-cell cultures for mimicking the tumor microenvironment. The optimized 3D spheroids cancer models can be applied for study the activation of cGAS-STlNG pathway. Next, the activity of 2'3'cGAMP agonist will be controlled by its specific delivery to cancer spheroids using functionalized silk nanoparticles.

Acknowledgments: The study is supported by Student Scientific Society Grant 133/2022 and by WCO Scientific Grant 26012023/ZIN/WCO/003

Application of a validated HPLC-UV method to assess the effectiveness of budesonide administration using an innovative aerosol delivery system

Authors: Julia Kerner (1), Adam Dembny (1), Franciszek Główka (1), Felix C. Wiegandt (2), Gerhard Pohlmann (2), Jan Mazela (3)
Affiliation: "(1) Department of Physical Pharmacy and Pharmacokinetic, Poznan University of Medical Sciences, (2) Fraunhofer Institute for Toxicology and Experimental Medicine, Translational Medical Engineering, Hannover, Germany,
(3) Department of Neonatology, Poznan University of Medical Sciences"
Tutor: Marta Karaźniewicz-Łada, PhD (1)

Introduction: Budesonide is a glucocorticoid used for the prevention and treatment of bronchopulmonary dysplasia, a chronic lung disease which is a significant cause of morbidity and mortality among preterm neonates. Low pulmonary availability of inhaled budesonide creates the need to develop optimized methods of aerosol delivery.

The aim of the study: The aim of the study was to develop and validate the HPLC-UV method for assessing the effectiveness of budesonide aerosol administration using an innovative aerosol delivery system (NADS).

Methods: A HPLC-UV method was developed for the quantification of budesonide deposited on glass-fiber filters which were used to evaluate the efficiency of NADS. The drug was extracted from the filters using methanol. Chromatographic separation was performed on a Kinetex C18 column with mobile phase consisted of water and methanol. UV detection was performed at a wavelength of 240 nm. The effectiveness of budesonide delivery using NADS and a standard delivery system was compared.

Results: The HPLC-UV method was linear in the budesonide concentration range of 0.1-20 µg/ml. Precision of the method was in the range of 1.6-18.6% and the accuracy amounted 1.3-16.7%. An extraction efficiency was > 97%. The stability of budesonide on filters stored for 5 days at room temperature was confirmed. The method was used to determine budesonide deposited on the filters during nebulization with NADS and a standard delivery system. The mean delivered dose was 13.6 µg, representing 5.4% of the nominal dose (250 µg). These values are about 3.6 times higher than those obtained using a standard delivery system (3.8 µg, or 1.5% of the nominal dose).

Conclusions: The developed HPLC-UV method was adequately accurate and precise and fulfilled the validation criteria. The usefulness of the method was confirmed for assessing the effectiveness of budesonide administration using NADS, which delivered 3.6 times more drug than using a standard device.

Acknowledgments: The study has been supported by EU Horizon 2020, MDOT project number 814654.

Bioavailability enhancement of herbal compounds : cyclodextrin complexation study of diarylheptanoids

Authors: Tymon Yu
Affiliation: Department of Pharmacognosy, Faculty of Pharmaceutical Sciences, Semmelweis University, Budapest, Hungary
Tutor: Dr. Ida Fejős PhD, Assistant professor

Introduction: Herbal compounds have played a significant role throughout the history of medicine, even more so in the modern pharmaceutical industry. They have been extensively utilised as scaffolds and templates for drug discovery and development, especially in oncology, where more than 80% of the new small-molecule anticancer drugs have come from natural compounds or their derivatives in the past four decades. Diarylheptanoid is a group of herbal compounds that possesses promising anticancer, anti-inflammatory, and antimicrobial effects but is limited by poor solubility and low bioavailability. Cyclodextrins (CDs) are natural cyclic oligosaccharides with a lipophilic central cavity that allows them to form inclusion-complexes with various compounds, thereby improving their stability, solubility, and overall bioavailability.

The aim of the study: The research aimed to evaluate the inclusion-complexes of eight diarylheptanoids and select a CD-based delivery system suitable for future pharmaceutical formulations of diarylheptanoids with low bioavailability.

Methods: The desired herbal constituents were separated and isolated from European hornbeam and European alder bark samples utilising HPLC systems. Their inclusion-complexes with three native CDs were prepared by diluting stock solutions with borate buffers containing different CD concentrations, and subsequently evaluated using affinity capillary electrophoresis (ACE).

Results: Linear diarylheptanoids displayed a much higher affinity for host CDs compared to cyclic derivatives. β-CD yielded the highest apparent complex stability constants, demonstrating the most favourable cavity size for linear diarylheptanoids, while only γ-CD was able to form effective complexes with cyclic derivatives.

Conclusions: CD complexation is a promising and viable technique with a wide range of applications in improving its enclosed subjects' aqueous solubility and stability, where it holds significant implications in the pharmaceutical industry. The ACE method serves as a simple, affordable, and fast screening test for selecting an optimum host CD in the event of unstable but therapeutically promising compounds with poor water solubility.

Development of liposomal formulations of sorafenib

Authors: Gabriela Soińska, Patrycja Ranicka, Dawid Sikora, Mikołaj Czajkowski, Paulina Skupin-Mrugalska
Affiliation: Department of Inorganic and Analytical Chemistry, Poznan University of Medical Sciences
Tutor: Paulina Skupin-Mrugalska

Introduction: Sorafenib (SOR) is a multikinase inhibitor with in vitro antiproliferative activity. Clinical indications of SOR include hepatocellular carcinoma, advanced renal cell carcinoma, and differentiated thyroid carcinoma. The registered formulation of SOR is administered orally in coated tablets. SOR bioavailability is relatively low (38-49%) and influenced by the prandial state; therefore, alternative formulations are required to increase therapeutic efficacy and bioavailability in advanced cancer.

The aim of the study: To develop liposomal sorafenib for alternative administration routes (e.g., intravenous or inhalation).

Methods: Liposomal sorafenib was manufactured by thin lipid film hydration and extrusion (TLH/E) or by the microfluidics (MF). The lipid composition of the liposomal membrane included: (i) structural phospholipid, i.e. L-α-phosphatidylcholine (egg PC) isolated from egg yolk or 1,2-dipalmitoyl-sn-glycero-3-phosphocholine (DPPC) (ii) cholesterol (chol) (iii) additional phospholipid, i.e. 1-palmitoyl-2-oleoyl-sn-glycero-3-(phospho-rac-(1-glycerol)) (POPG). Liposome size and its stability were determined using dynamic light scattering, while HPLC/DAD was used to determine encapsulation efficiency. The impact of the components and preparation technique on liposome characteristics was evaluated.

Results: The particle size of developed liposomes covered the range 130.0 – 216.2 nm and 36.1 – 151.7 nm for the TLH/E and MF methods, respectively. Liposomes obtained by the MF method were characterized by higher PDIs and SOR incorporation efficiency than carriers obtained by the TLH/E. The lowest SOR incorporation efficiency, the largest particle size, and size distribution, and low storage stability characterized liposomal formulations containing DPPC. The desired parameters were obtained for egg PC/chol/POPG liposomes manufactured by the MF, with 45.1% incorporation efficiency, and 45.5 nm particle size. The storage stability was preserved over 30 days.

Conclusions: Liposomal SOR was obtained successfully. Among all formulations developed, SOR/egg PC/chol/POPG liposomal formulation was selected for further research, while the microfluidic mixing technique was chosen as the preferred manufacturing method.

The effect of dissolution media on the combined dissolution/permeation behavior of fenofibrate solid dispersion in mixed phospholipid/polymer matrices

Authors: Aleksandra Słaba, Mikołaj Czajkowski, Martin Brandl, Paulina Skupin-Mrugalska
Affiliation: Department of Inorganic and Analytical Chemistry, Poznan University of Medical Sciences, Department of Physics, Chemistry and Pharmacy, University of Southern Denmark
Tutor: Martin Brandl, Paulina Skupin-Mrugalska

Introduction: Unlike traditional dissolution media, biorelevant media attempts to mimic the nature of the dissolution process in the gastrointestinal (GI) tract, incorporating similar concentrations of bile salts and phospholipids while replicating the pH and osmolarity conditions. Biorelevant media aim to mimic the complex and dynamic conditions within the human body, providing a more realistic environment for in vitro studies, which is important during drug and formulation development.

The aim of the study: To investigate the influence of biorelevant media on the combined dissolution/permeation of fenofibrate (FEN) solid dispersion in polymer/phospholipid matrices.

Methods: Solid dispersions composed of FEN, co-povidone and/or phospholipids (with various content of hydrogenated phosphatidylcholine) were manufactured by hot-melt extrusion (70 rpm, 120 °C, 5 minutes, closed-flow system). The combined dissolution/permeation experiments were conducted using a 96-well PermeaPlain Plate with a cellulose membrane placed between the donor and acceptor (37°C, stirred at 500 rpm, 5 h). Fasted and Fed State Simulated Intestinal Fluids (FaSSIF and FeSSIF, respectively) served as dissolution media, and the acceptor medium was 1.5% SDS in FaSSIF or FeSSIF blank buffer, respectively. FEN concentrations were quantified by UPLC.

Results: FEN concentrations in the donor compartment were consistently higher in FeSSIF than in FaSSIF. On the contrary, higher concentrations of FEN in the acceptor compartment, which correspond to permeated FEN, were observed when FeSSIF was used as a dissolution medium.

Conclusions: Higher concentrations of FEN in FeSSIF are attributed to the increased content of solubilizing agents (bile salts, phospholipids), which enhance the drug's apparent solubility and dissolution. However, the better permeation observed in FaSSIF suggests that lower surfactant concentration may contribute to improved drug permeation by preventing the entrapment of the drug within micellar structures. Therefore, it should be noted that true solubility and supersaturation triggers the higher permeability of poorly soluble drug substance.

Acknowledgments: Research supported by Phospholipid Research Centre (PSM-2020-085/1-1)

The effect of oil phase composition and homogenization process on emulsi on properties

Authors: Tomasz Przybylski, Joanna Czerniel
Affiliation: Department of Pharmaceutical Chemistry, Poznan University of Medical Sciences, Rokietnicka 3, 60-806 Poznan, Poland
Tutor: Assoc. Prof., Ph.D. Maciej Stawny; Assoc. Prof., Ph.D. Aleksandra Gostyńska

Introduction: Intravenous lipid emulsions (ILEs) are an inseparable part of nutritional therapy. However, long-term parenteral nutrition can lead to a liver disorder known as IFALD. One of the factors involved in the pathogenesis of IFALD is the intravenous administration of phytosterols derived from vegetable oils. Modifying the oil phase's composition in ILEs can reduce the content of phytosterols administered intravenously. Due to the use of ILEs in the medical field, they must meet specific standards and safety norms. Referring to the USP, the size of lipid particles should not exceed 500 nm.

The aim of the study: The study aimed to develop ILEs with reduced phytosterol content (based on theoretical values) differing in the oil phase composition and to investigate the effect of selected components on the physicochemical properties and stability of the emulsion.

Methods: Three systems designated as ILE-1, ILE-2, and ILE-3 were prepared. The composition of all ILEs was based on the same content of egg yolk lecithin, sodium oleate, glycerol, and water. The oil phase was characterized by the presence of MCT, fish oil, and rapeseed oil, to which were added, respectively: sunflower oil and hemp oil (ILE-1), avocado oil and soybean oil (ILE-2), and soybean oil (ILE-3). The homogeneous systems were obtained using sonication, followed by high-pressure homogenization.

Results: All formulations showed mean droplet diameter (MDD) below 200 nm, negative zeta potential, and pH ranging from 6.26 to 8.01. The lowest value of MDD of 179.6±6.2 nm was recorded for ILE-2. Short-term stability tests conducted at 4°C ±1°C and 25°C ±1°C without light exposure showed satisfactory emulsion stability for 21 days of storage.

Conclusions: To sum up, the oil phase's composition affected the emulsion's physicochemical properties and stability. However, for all developed formulations, parameters appropriate for intravenous administration were obtained, which makes the tested ILEs promising for further research and development.

Acknowledgments: This work was funded by grant LIDER/17/0092/L-12/20/NCBR/2021 from the National Centre for Research and Development, Poland.

Evaluation of surface properties of surface-active ionic liquids based on pelargonic acid.

Authors: Klaudia Kaźmierczak, Marta Wojcieszak PhD student, Anna Syguda PhD
Affiliation: Poznan University of Technology, Faculty of Chemical Technology, Berdychowo 4 Street, PL-60965, Poznan, Poland
Tutor: Katarzyna Materna Professor

Introduction: Among the various types of ionic liquids, a particularly intriguing category is represented by those with surface activity. The significant appeal of these compounds arises from their distinctive structure, enabling i.e., easy adsorption at the water-air interface or wettability. While there is a wealth of knowledge about many surface-active ionic liquids (SAILs), constant efforts are devoted to discovering new compounds with even more beneficial properties. Especially those based on natural cations or anions. SAILs can be used in a variety of industrial sectors for example, in medicine as part of drugs.

The aim of the study: The aim of this study was to investigate the surface activity of a newly SAILs based on pelargonic acid.

Methods: Surface tension of compounds was determined using the shape drop method. For confirmation surface activity, the parameters were investigated, such as critical micelle concentrations (CMC), surface tension at CMC (γCMC) and efficiency of surface adsorption on an air–water interface (pC20). Also, wettability of compounds was measured using the contact angle (CA). Wettability measurements were carried out on different surfaces, with varying degrees of hydrophobicity.

Results: The presented studies showed significant surface activity of the analysed SAILs based on pelargonic acid. Moreover, it has been proved that with prolongation of alkyl chain the surface activity of compounds increased.

Conclusions: Amphiphilic compounds exhibit a tendency to reduce the surface tension to 23.4–30.2 mN m-1, so they can behave as cationic surfactants. The surface activity of compound's manifests in micellization tendency and contact angle values lower than 90 degrees.

Acknowledgments: This work was funded by the Ministry of Education and Science in Poland (0912/SBAD/2308).

Heteroleptic zinc(II) aza-dipyrromethene complexes - Synthesis and spectral properties

Authors: Milena Kasprzak
Affiliation: Chair and Department of Inorganic and Analytical Chemistry, Poznan University of Medical Sciences, Rokietnicka 3, 60-806 Poznan, Poland
Tutor: Michal Kryjewski, Ph.D.

Introduction: Aza-dipyrromethenes (ADPMs) are a class of synthetic molecules that exhibit significant light absorption within the visible and near-infrared spectral regions. These molecules, owing to their optical properties, are referred to as potential photosensitizers for applications in photodynamic therapy (PDT). The formation of metallic complexes occurs through the direct reaction between metal cations and ADPM ligands featuring specific substituents.

The aim of the study: The aim of the study was to synthesize and investigate optical properties of novel heteroleptic complexes, which contain two different ADPM moieties and a zinc(II) ion.

Methods: ADPM ligands were synthesized by three-step process including aldol condensation, Michael addition and second condensation. The structural modifications of the ligands included hydroxyl, nitro, methyl, and 2-(morpholin-4-yl)ethoxy substitutions at the proximal and distal phenyl rings. ADPM complexes were obtained by mixed complexation reaction of two different ADPM ligands with zinc(II) acetate in o-dichlorobenzene. Each reaction resulted in the formation of three compounds - one heteroleptic and two homoleptic complexes. Molecules were separated using chromatographic techniques. All syntheses were performed in laboratory-scale quantities and were carried out under inert atmosphere.

Results: The synthesis of the complexes involved conducting direct complexation reactions between substituted aza-dipyrromethene ligands and zinc(II) salt. Molecular structures were investigated using NMR analyses and mass spectrometry (MS/ESI). UV-VIS studies were conducted in toluene, chloroform, tetrahydrofuran (THF) and N,N-dimethylformamide (DMF).

Conclusions: The application of mixed complexation reactions proves to be an effective method for synthesizing heteroleptic aza-dipyrromethene complexes. Strong absorption of the red part of visible spectrum is considered optimal for photodynamic therapy.

Modification of phthalocyanines with nipagin towards better photocytotoxicity against fungi and multi-drug resistant microbes

Authors: Daniel Ziental; Dariusz Mlynarczyk; Emre Güzel; Jolanta Dlugaszewska; Łukasz Popenda; Tomasz Goslinski; Jakub Szymczyk; Łukasz Sobotta
Affiliation:
1 Chair and Department of Inorganic and Analytical Chemistry, Poznan University of Medical Sciences, Grunwaldzka 6, 60-780 Poznan, Poland
2 Chair Department of Chemical Technology of Drugs, Poznan University of Medical Sciences, Grunwaldzka 6, 60-780 Poznan, Poland
3 Department of Engineering Fundamental Sciences, Sakarya University of Applied Sciences, Sakarya, Turkiye
4 Chair and Department of Genetics and Pharmaceutical Microbiology, Poznan University of Medical Sciences, Swiecickiego 4, 60-781, Poznan, Poland
5 NanoBioMedical Centre, Adam Mickiewicz University, Wszechnicy Piastowskiej 3, 61-614 Poznan, Poland

Introduction: The antibiotic resistance phenomenon constitutes a growing problem in medicine. For this reason, alternative procedures such as photodynamic antimicrobial therapy (PACT) are more and more popular due to their efficiency. The problem with PACT lies in finding the best photosensitizer, possessing both high stability and singlet oxygen generation is still a great challenge. One of the most active compounds are related to poprhyrins, especially their aza-derivatives such as phthalocyanines (Pcs). The interest in Pcs is rising due to their beneficial spectroscopic properties: poor absorbance in 400-600 nm range reducing the risk of phototoxic reacions and high between 600 and 800 nm that guarantees sufficient tissue penetration. Their main drawback is poor solubility in water, and thus in body fluids, being a difficulty for their application in medicine. To overcome this problem, Pcs are often enclosed in liposomes, to achieve better delivery. The mechanism of PACT relies on application of non-toxic dye, which can be excited with light of specific wavelength and then react with oxygen molecules, yielding highly cytotoxic singlet oxygen, able to oxidize and disrupt cell membranes, leading to their death.

The aim of the study: Bacteria and fungi.

Methods: The compounds were obtained by demetallation of nipagin-substituted magnesium phthalocyanine and subsequent metalation with zinc(II) acetate or bis(benzonitrile)palladium(II) chloride. Their spectral properties, photostability and singlet oxygen generation with 1,3-diphenylisobenzofuran (DPBF) were measured using spectrophotometric methods. The compounds were then enclosed in liposomes consisting of palmitoul-oleoyl phosphatidylcholine (POPC) and dioleoyl-3-trimethylammoniumpropane (DOTAP) by thin film hydration method. Obtained formulations were then used for antimicrobial activity assessment towards Candida auris and selected bacteria and fungi strains.

Results: The compounds were synthesized with 82% (H2Pc), 92% (ZnPc) and 84% (PdPc) yield. They remained stable during irradiation in DMF, although in DMSO H2Pc and PdPc decomposed partially. Metallated Pcs were more effective in singlet oxygen generation ($\Phi\Delta$ = 0.55 in DMF and 0.72 in DMSO for ZnPc, and 0.73 in DMF and 0.77 in DMSO for PdPc), than demetallated one ($\Phi\Delta$ = 0.03 in DMF and 0.10 in DMSO), as compared to standard, unsubstituted zinc phthalocyanine ($\Phi\Delta$ = 0.56 in

DMF and 0.67 in DMSO). The phthalocyanines presented good activity towards various microorganisms, achieving up to 5.5 log reduction at best.

Conclusions: Nipagin-functionalized phthalocyanines with various metals achieved higher antibacterial activity and singlet oxygen generation than the demetallated one, although their performance was not directly associated with their photostability.

1. Ziental, D. et al. Zinc(II), Palladium(II), and Metal-Free Phthalocyanines Bearing NipaginFunctionalized Substituents against Candida auris and Selected Multidrug-Resistant Microbes. Pharmaceutics 2022, 14, 1686.

Modification of the implant surface with Langmuir film containing hydroxyapatite and DPPC

Authors: Justyna Kurnatowska*, dr inż. Katarzyna Adamska,
Affiliation: Poznan University of Technology, Institute of Chemical Technology and Engineering, Berdychowo 4, 60-965 Poznan, *justyna.kurnatowska@student.put.poznan.pl
Tutor: dr inż. Monika Rojewska (monika.rojewska@put.poznan.pl), prof. dr hab. inż. Krystyna Prochaska

Introduction: The modification of implants surface for better osseointegration has raised increasing attention in modern orthopedic medicine. One of the promising method is preparing and depositing thin film to change surface properties and improve biocompatibility of biomaterial. The Langmuir-Blodgett films could be applied as coatings for polylactides (PLAs). PLA are notably interesting material as an implant due to their bioresorbability. But their hydrophobicity and the lack of specific functional groups to promote cell adhesion are not enhance the osteogenesis process. It is reasonable to expect that covering PLAs surface with a film containing hydroxyapatite particles (HA) will produce a favorable response of the bone tissue.

The aim of the study: In our research, we prepared a new thin film by Langmuir monolayer technique. To achieve the most satisfactory effect, we prepare two component film containing modified HA particles and phospholipids (DPPC). The research was carried out using two methods: 1) mixing HA with DPPC and spreading the solution at the interface and 2) creating a phospholipids monolayer at the interface and then dropping HA dispersion on a lipid surface.

Methods: The research was conducted using the Langmuir-Blodgett technique. The morphology of the obtained films were visualized using a BAM (KSV Nima) microscope coupled with a Langmuir trough. The modificated HA particles were identified and examined based on SEM analysis and FTIR spectra.

Results: The obtained π-A isotherm data provided information about the film structures, phase transition, compressibility and interactions between DPPC and modified HA particles.

Conclusions: It can be concluded that using the Langmuir technique it is possible to obtain mixed films containing a modified HA and DPPC molecules at the air/water interface. The better way of preparing film was to deposit hydroxyapatite particles onto a previously formed DPPC layer. This method is a promising way for modifying the coatings of bone replacement parts but requires further research.

Acknowledgments: This research was funded by the Ministry of Education and Science, Poland, no. 0912/SBAD/2301 and no. 0912/SIGR/8058.

Physicochemical characterization of Soluplus-based nanocarrier for curcumin

Authors: Karolina Kustrzyńska, Maciej Stawny
Affiliation: Department of Pharmaceutical Chemistry, Poznan University of Medical Sciences, Rokietnicka 3, 60-806 Poznan, Poland
Tutor: Assoc. Prof., Ph.D. Maciej Stawny

Introduction: Curcumin is a plant-derived compound with a pleiotropic effect. It shows many beneficial activities such as antimicrobial, anti-inflammatory, antioxidant, and anti-cancer. However, its low solubility and bioavailability limit its use in treating many diseases. Interesting carriers of hydrophobic drugs are polymeric micelles. Such systems allow for increasing the solubility of drugs in aqueous solutions.

The aim of the study: The study aimed to examine the stability of Soluplus micelles loaded with curcumin in different stress conditions. The mean particle diameter, zeta potential, polydispersity index, pH, osmotic pressure, and compound content were measured.

Methods: Polymeric micelles were obtained by the thin film hydration technique. Both loaded and unloaded formulations were developed. The resulting carriers were subject to different stress factors (light, alkaline, and acidic pH, and exposition to an oxidizing agent) to evaluate their impact on the stability of the developed formulation.

Results: Polymeric micelles with and without curcumin were found to be highly sensitive to alkaline pH. After the addition of 0.1M sodium hydroxide solution, an increase in the particle size occurred. In the case of acidic pH and an oxidizing agent, smaller changes in the studied parameters were noticed over the time of the experiment. The results of photostability tests showed that after 22 h, curcumin incorporated into polymeric micelles was completely degraded. In comparison, the time of curcumin degradation after exposing the developed formulation to 0.1M sodium hydroxide was 168 h.

Conclusions: Developed curcumin-loaded polymeric micelles are carriers that significantly increase the water solubility of curcumin. The applied stress factors influenced particle size, polydispersity index, zeta potential, pH, osmotic pressure, and curcumin content in polymer micelles.

Acknowledgments: This work was funded by grant LIDER/17/0092/L12/20/NCBR/2021 from the National Center for Research and Development, Poland.

Preliminary studies on a microneedle system with protoporphyrin IX of potential use in the treatment of skin cancer

Authors: Agata Roszak 1)*, Beata Czarczyńska-Goślińska 1), Anna Froelich 1), Irena Budnik 1), Tomasz Gośliński 2), Tomasz Osmałek 1)
Affiliation: 1) Chair and Department of Pharmaceutical Technology, Poznan University of Medical Sciences, Rokietnicka 3, 60-806 Poznan, Poland
2) Chair and Department of Chemical Technology of Drugs, Poznan University of Medical Sciences, Rokietnicka 3, 60-806 Poznan, Poland
*aroszak40@gmail.com
Tutor: Tomasz Osmałek 1)

Introduction: The increase in the occurrence of malignant skin cancers becomes of more and more concern. Among various methods of cancer treatment Photodynamic Therapy (PDT) seems an alternative to traditional therapies due to its safety, low price, and effectiveness limited to topical use.

The aim of the study: Preparation of a microneedle system with PPIX and preliminary selection of a coating polymer and solvent composition for the release studies

Methods: Sodium alginate, xanthan and poloxamer hydrogels containing 0,1% PPIX and placebo hydrogels were prepared. The loss of volatile substances and the rheological properties of these hydrogels were investigated. Pyramid-shaped microneedles were printed by stereolitography (SLA) and coated manually with each hydrogel. All polymer-coated microneedle systems were subjected to PPIX elution analysis in ethanol, phosphate buffer pH 7.4, ethanol-phosphate buffer pH 7.4. PPIX fluorescence was measured using a Jasco spectrofluorimeter.

Results: The volatility values of the PPIX hydrogels were slightly lower than those of the placebo hydrogels, and the loss of volatile components in both cases was small within 6 hours. Hysteresis loops plotted for all hydrogels and placebo hydrogels indicated their thixotropic properties. The average dynamic viscosity resulted in the hydrogels not resisting the flow under the influence of the applied shear stress. All microneedle systems were coated with selected polymers and subjected to PPIX elution analysis in various media.

Conclusions: In the PPIX elution analysis in various media, only poloxamer-based hydrogel completely released PPIX to the mixture of ethanol with phosphate buffer pH 7.4 80:20 v/v (the highest fluorescence intensity) and it was selected for further release studies.

Acknowledgments: The study was performed thanks to financial support from the National Science Center Poland - grant no. 2023/07/X/NZ7/00714.

Preparation of thin buccal films using the Langmuir-Blodgett technique

Authors: Klaudia Krupa*, Karolina Gretkowska
Affiliation: "Poznan University of Technology, Institute of Chemical Technology and Engineering, Berdychowo 4, 60-965 Poznan
*klaudia.krupa@student.put.poznan.pl
Tutor: dr inż. Monika Rojewska, monika.rojewska@put.poznan.pl; prof. dr hab. inż. Krystyna Prochaska, krystyna.prochaska@put.poznan.pl

Introduction: The development of mucoadhesive buccal films has become a promising delivery alternative to various therapeutic antibacterial and antifungal substances. One of the method to form thin films is the Langmuir-Blodgett technique. This technique enables a high controlled formation of nanomaterials films and transport this film on a solid substrate. Langmuir monolayer technique is universal and can be applied to any materials that can float on the subphase; it was especially employed to produce lipid or protein monolayer. Currently, various biomolecules can be incorporated into lipid monolayer to form mixed and hybrid films. The Langmuir films are prepared by two main approach. One approach is to disperse the nanomaterials in the subphase and to compress molecule at the air/water interface. Another approach is based on mixing the molecules with nanomaterials and compression of their dispersion at the interface, what allows to investigate the interactions with biological systems at the molecular level.

The aim of the study: In our research we prepared an antibacterial film for oral application. First, we investigated surface properties of film's components: mucoadhesive polymers (i.e HPMC, HEC, chitosan etc.), phospholipids (DPPC) and modified HA particle. Then, the interactions between phospolidids and mucoadhesive polymers or HA particles were studied. After that, a hybrid films with different contents of individual components were forming.

Methods: Langmuir monolayer technique was applied to create a thin film containing HA particles, mucoadhesive polymer and phospholipids. The morphology of the films was analyzed using BAM microscopy.

Results: The obtaining mixed films were characterized in detail on the basis of the surface pressure (π)-area (A) isotherms and compressibility modulus (Cs)-surface pressure (π) isotherms. The π-A isotherm data provided information about the film structures, phase transition, compressibility and interactions between films components.

Conclusions: The obtained results have shown that the Langmuir monolayer technique allow to prepare a stable mixed films composed of DPPC, mucoadhesive polymer and modified HA particles. This is a promising direction in creating films with the required biocompatibility and bioactivity.

Acknowledgments: This research was funded by the Ministry of Education and Science, Poland, no. 0912/SBAD/2301.

Thermal behaviour and stability of the spray-dried co-amorphous carvedilol phosphate-lovastatin system

Authors: Agata Olszewska[1], Christopher Hoban[2], Natalie Parkinson[2], Brian F. Woodfield[2], Marcin Skotnicki[1]
Affiliation:
1. Chair and Department of Pharmaceutical Technology, Poznan University of Medical Sciences, Poznan, Poland
2. Department of Chemistry and Biochemistry, Brigham Young University, Provo, UT 84602, USA

Introduction: Cardiovascular diseases (CVDs) are considered to be one of the most frequent causes of death in developed countries. Due to polytherapy and consequently, patients' non-adherence to medication taking, new therapeutic strategies are being implemented. One of the strategies is a combination of two or more active pharmaceutical ingredients (APIs) into one dosage form (fixed-dose combination, FDC). Carvedilol phosphate (CAR_P) and lovastatin (LOV) are poorly soluble drugs often used together in the treatment of CVDs, therefore, combining them into one dosage form can benefit non-adherent patients. Furthermore, poor solubility of crystalline APIs might decrease the bioavailability of the drug. The API in the amorphous phase usually shows a higher dissolution rate and, therefore, might increase the bioavailability of the drugs in comparison to their crystalline counterparts. However, as the amorphous phase is not in equilibrium, the API might crystallise during the storage of the formulation and the beneficial properties might be lost.

The aim of the study: In order to properly design the formulation, the solid-state properties of APIs need to be characterised. In these studies, the thermal behaviour and stability of the co-amorphous CAR_P-LOV system obtained by spray drying were examined.

Methods: The co-amorphous samples were prepared by spray drying and characterised by using calorimetric methods, i.e., Quantum Design Physical Property Measurement System® (PPMS) and Differential Scanning Calorimetry (DSC) supported by the Powder X-Ray Diffractometry (PXRD). The system was stored for up to 5 months at 20°C to estimate the physical and chemical stability. The chemical stability was tested by NMR spectroscopy.

Results: Using PPMS, the heat capacities were measured, the functions describing heat capacity at low temperatures and the Debye-Einstein function for high temperatures were obtained, and the thermodynamic functions were calculated. DSC analysis revealed a single glass transition in the spray-dried sample, suggesting co-amorphisation of the system. PXRD analysis of the spray-dried material confirmed the amorphous nature of the system. The stability studies showed that the system was physically (no crystallisation occurred) and chemically stable for up to 5 months.

Conclusions: The system may be potentially used for the development of FDC.

Acknowledgments: The work was supported by the National Science Centre, Poland, in the frame of grant Miniatura 6, No:2022/06/X/ST5/00625 (Id: 555500).

PhD STUDENTS' SESSION

Chemical tool for imaging changes in the cellular environment - fluorescent molecular probe

Authors: Piotr Michałowski M.Eng., Dorota Jakubczyk PhD, Jacek Kolanowski DSc
Affiliation: Poznan University of Technology, Institute of Chemical Technology and Engineering Berdychowo 4, 60-965 Poznań Institute of Bioorganic Chemistry Polish Academy of Sciences Z. Noskowskiego 12/14, 61-704 Poznań
Tutor: Katarzyna Bielicka – Daszkiewicz DSc, Eng.

Introduction: Fluorescent molecular probes are an identifying group of compounds. By altering their optical properties, they can act as tracers to gain a better understanding of biological systems and the transformations they undergo.

The aim of the study: Design and determination of identifiable factors by a fluorescent molecular probe for imaging environmental changes of parameters in the cell.

Methods: Six-step synthesis was performed to obtain the molecular probe based on caffeic acid and a cumarin derivative, which are linked by a diamine linker. The resulting probe was characterised in detail in terms of its fluorescence properties and its sensitivity to varying environmental factors in an in vitro system.

Results: The first step of the synthesis involved the preparation of two components, a derivative of cumarin and a linker blocked on one side of the amino group. In a further step, the catalysts DIPEA and HATU were employed for the efficient formation of amide bond. A basic raw material was obtained, which reacting with caffeic acid, enabled a fluorescent molecular probe to be obtained. Its detailed fluorescence analysis allowed the determination of a maximum excitation wavelength of 425nm and a maximum emission wavelength of 475nm. The molecule decreases its excitation and emission intensity when in contact with iron ions or reactive oxygen species, which are present during oxidative stress or in cancer cells. In addition, the molecular probe is ratiometric in terms of changes in viscosity and polarity, which can potentially be used to identify the delivery of a therapeutic agent into a biological system.

Conclusions: Resulting fluorescent molecular probe possesses properties of a potential probe for the identification of iron ions, reactive oxygen species or changes in cell polarity or viscosity, which can take place during biochemical analysis of selected cells or testing of topically programmable therapeutics.

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

Cytotoxicity and α-Synuclein Anti-Amyloid Activity of Carbon-Based Nanomaterials

Authors: Tuba Oz[1], N. Palaniappan 2 , Ivan Cole 3 , Małgorzata Kujawska[1]
Affiliation: [1]Department of Toxicology, Poznan University of Medical Sciences, Poznań, Poland
2 School of Chemical Sciences Central University of Gujarat, Gujarat, India
3 Advanced Manufacturing and Fabrication School of Engineering RMIT University Melbourne VIC 3000, Melbourne, Australia

---

Introduction: Proteins in soluble monomers exert physiological functions, which are lost after converting them into insoluble amyloids. Synucleinopathies are a diverse group of neurodegenerative diseases (e.g. Parkinson's disease) characterized by the abnormal accumulation of aggregated insoluble α-synuclein (ASN) protein in selectively vulnerable populations of neurons. Targeting the surfaces of ASN inclusions is suggested to hold the unmet therapeutic and diagnostic needs projected to be managed by exploring alternative strategies.

The aim of the study: To investigate the potential of lanthanum-dopped carbon nanotube materials (La-CNTs) to target synucleinopathy in vitro.

Methods: Here, we studied the anti-amyloid activity of La-CNTs to the ASN preformed fibrils (PFFs) with reference to its normal helical monomer based on fluorometric (thioflavin T) and spectrophotometric (turbidity assay) measurements and assessed the cytotoxicity of tested La-CNTs in human dermal fibroblast (HDF) cell line.

Results: We found that La-CNTs affected the stability of PFFs while not interacting with the monomer form of ASN. Moreover, no severe toxicity on HDFs was observed.

Conclusions: La-CNTs are considered for further examination against synucleinopathy.

Acknowledgments: The project was supported by Narodowe Centrum Nauki, No. 2021/42/E/NZ7/00246.

DNA Under Fire: Evaluation of Double and Triple Combinations of Cisplatin, Olaparib, and KDM Inhibitors in a Head and Neck Cancer Model

Authors: Dawid Dorna and Robert Kleszcz
Affiliation: Department of Pharmaceutical Biochemistry, Poznan University of Medical Sciences, ul. Rokietnicka 3 60-806 Poznan, Poland
Tutor: Jarosław Paluszczak, Ph.D., Associated Professor

Introduction: The malfunction of the homologous recombination (HR) DNA repair pathway in BRCA-mutated cancers justifies the use of PARP inhibitors in therapy. Recent studies have revealed that the inhibition of certain histone lysine demethylases (KDMs) interferes with the HR pathway. This led us to investigate whether disrupting HR with KDM inhibitors could sensitize cancers with infrequent BRCA mutations to PARP inhibitors, such as olaparib.

The aim of the study: This study aims to explore whether double combinations of KDM inhibitors with olaparib or cisplatin, or a triple combination with both olaparib and cisplatin, would result in the accumulation of DNA damage and enhanced cytotoxicity in head and neck squamous cell carcinoma (HNSCC) cells.

Methods: HNSCC cell lines (FaDu and SCC-040) were treated with KDM inhibitors (GSK-J4, ML324, JIB-04, and CPI-455), cisplatin, and olaparib. Cell viability, apoptosis, and DNA damage were assessed using the resazurin assay, Annexin V staining, and H2A.X activation, respectively. Statistical significance ($p \leq 0.05$) was determined using appropriate tests, including ANOVA and Student's t-test.

Results: All studied compounds decreased viability and induced apoptosis in the examined cell lines, with JIB-04 demonstrating the greatest potency. Combining KDM inhibitors with cisplatin enhanced the cytotoxic effect, in contrast to combinations with olaparib. Triple combinations of KDM inhibitors (especially GSK-J4 and JIB-04) with cisplatin and olaparib exhibited the best cytotoxic activity. All studied compounds, except CPI-455, induced DNA damage, which was potentiated in cells treated with double combinations of KDM inhibitors with olaparib and triple combinations with olaparib and cisplatin.

Conclusions: Double combinations of KDM inhibitors (particularly GSK-J4 and JIB-04) with cisplatin, and triple combinations with cisplatin and olaparib represent a promising therapeutic strategy for treating HNSCC and should be further evaluated.

Acknowledgments: Research was financed from the small research grant from statutory funding for young researchers - doctoral students for 2023. Young Scientist NMN0000085

Formulation of microfibers containing modified release omeprazole by triaxial electrospinning method.

Authors: Justyna Srebro MPharm, Ewelina Łyszczarz PhD
Affiliation: Department of Pharmaceutical Technology and Biopharmaceutics, Jagiellonian University Medical College, Cracow
Tutor: Prof. Aleksander Mendyk, Witold Brniak PhD

Introduction: Omeprazole is a proton pump inhibitor, considered as the golden standard in the treatment of gastroesophageal reflux disease. However, due to its short half-life, it is not used for the treatment of nocturnal acid breakthrough. A solution to this therapeutic challenge may be the development of sustained-release dosage forms of omeprazole. However, this approach poses a major technological challenge due to omeprazole's instability in an acidic environment.

The aim of the study: The aim of the study was to develop omeprazole-containing microfibres using functional polymers to achieve delayed and sustained release of the therapeutic substance simultaneously.

Methods: In the first stage of research, ethanolic solutions of the polymers Eudragit RS, Eudragit RL, and polyvinylpyrrolidone (PVP) were prepared in various proportions, in which the drug substance was then dispersed and spun. Subsequently, the sustained-release formulation with the most satisfactory release profile over the 8 h of testing was selected. The chosen formulation was used for triaxial spinning as a microfibre core, which was then coated with a layer of inert polymer and eventually with an enteric polymer - Eudragit S100. The obtained microfibres were subjected to microscopy, DSC, XRPD, and dissolution studies.

Results: Sustained-release microfibres presented satisfactory mechanical properties and extended release of omeprazole for up to 8 h. Depending on the composition and proportion of polymers used, differences in the release profiles of omeprazole were observed. The highest amount of drug substance was released from microfibres with the highest content of the inert polymer PVP. Microfibers produced by the triaxial spinning method were characterized by satisfactory mechanical properties, although decreased barrier properties.

Conclusions: Conducted studies have shown that it is possible to produce microfibres with extended release of omeprazole for up to 8 hours, as well as microfibres with dual-release modification using the triaxial spinning method. It is planned to optimise the triaxial formulation further.

Acknowledgments: This research was funded by the Jagiellonian University — Medical College (grant numbers N42/DBS/000261, N42/DBS/000364) and the Faculty of Pharmacy, Jagiellonian University Medical College under the Strategic Program Excellence Initiative at Jagiellonian University (grant number U1C/W42/NO/28.13). The purchase of the equipment has been supported by a grant from the Priority Research Area qLIFE under the Strategic Programme Excellence Initiative at Jagiellonian University (grant number U1C/P04/NO/04.04).

The impact on cell survival of selected polyphenols and mixtures of parenteral nutrition on human hepatocyte and cholangiocyte cell lines

Authors: Marta Belka, Aleksandra Gostyńska, Maciej Stawny, Violetta Krajka-Kuźniak
Affiliation:
Department of Pharmaceutical Biochemistry, Poznan University of Medical Sciences, Rokietnicka 3, 60-806 Poznan, Poland
Department of Pharmaceutical Chemistry, Poznan University of Medical Sciences, Rokietnicka 3, 60-806 Poznan, Poland
Tutor: Prof., Ph.D. Violetta Krajka-Kuźniak; Assoc. Prof., Ph.D. Aleksandra Gostyńska

Introduction: PNALD is a severe liver injury caused by factors related to intestinal failure and parenteral nutrition (PN). Recent studies show that activation of the FXR receptor may be a new therapeutic target in PNALD and may play a key role in preventing and treating this disease. Literature data indicate the therapeutic potential of natural compounds in liver diseases. Some of these compounds exhibit FXR receptor agonist properties. However, no studies were found regarding the use of natural FXR agonists in PNALD. Therefore, in order to thoroughly understand this issue, our preliminary research included a cytotoxicity assessment of these compounds in relation to the liver.

The aim of the study: Our preliminary study aimed to assess the cytotoxicity of selected polyphenols and mixtures of parenteral nutrition on the normal hepatocytes and human cholangiocytes.

Methods: The human normal hepatocytes THLE-2 cell line and human cholangiocytes (CHOL) line were treated and incubated with thirteen different polyphenols and parenteral nutrition admixtures impact on cell viability.

Results: Our results demonstrated that in the concentration range 1-100 µM, all studied polyphenols reduced both cell types' viability in a dose-dependent manner. The investigated polyphenols such as honokiol, magnolol, withaferin, boswellic acid, nobiletin, isorhamnetin, fisetin, cyanidin, delphinidin, malvidin, pelargonidin, petunidin, and peonidin were similarly toxic in case both tested cell lines. However, we observed a greater effect in cholangiocytes than hepatocytes in the case of withaferin. In the case of the cytotoxicity study of mixtures for parenteral nutrition, the most potent effect was observed for Kabiven.

Conclusions: The study showed a high cytotoxic effect of withaferin in both tested cell lines. However, in order to understand the impact of the tested polyphenols, further research is necessary.

Acknowledgments: This work was funded by grant OPUS no. 2022/45/B/NZ7/01056 from the National Science Centre, Poland.

Introduction of "green chemistry" principles into the synthetic pathway of dibromo- and tetrabromocurcuminoids with potential antimicrobial activity

Authors: Eduard Potapskyi
Affiliation: Department of Chemical Technology of Drugs, Poznan University of Medical Sciences, Rokietnicka 3 Street, 60-806 Poznan, Poland
Tutor: Prof. Tomasz Gośliński, Assistant prof. Marcin Wierzchowski

Introduction: Curcumin is a polyphenolic compound of natural origin. It is a compound with a broad spectrum of therapeutic activities (anti-cancer, anti-inflammatory, antioxidant, hepatoprotective) while having low toxicity. Numerous studies report bactericidal and bacteriostatic effects through various mechanisms of action. Green chemistry, also called sustainable chemistry, is an area of chemistry focused on the design of products and processes that minimize or eliminate the use and generation of hazardous substances.

The aim of the study: The main objective of the study is to develop a method for the synthesis of modified curcumin derivatives, as well as modifying the methods of synthesis of these compounds guided by the principles of "green chemistry".

Methods: The new compounds were obtained by condensation of the corresponding aldehydes with an acetylacetone complex and BF2. 1-Butylamine was used as the catalyst for the reaction, with toluene as the solvent. The decomplexation reaction was then carried out under microwave conditions. The reaction was carried out in a mixture of methanol : water (4:1) with sodium oxalate.

Results: Ten new compounds were obtained, of which five were curcuminoid complexes with BF2, and five were free curcuminoids. The microwave assisted synthesis of free curcuminoids was modified according to the principles of "green chemistry."

Conclusions: The selected reactions are a good and efficient way to obtain selected curcuminoids and their complexes with BF2. In accordance with the principles of "green chemistry," part of the organic solvent was replaced with water in the decomplexation reaction to reduce toxic waste. Sodium oxalate, a naturally occurring compound, was also used. Using a microwave reactor, it was possible to significantly reduce the reaction time (to 15 minutes), reducing energy consumption. Thanks to the fact that the system is closed, pollution of the atmosphere by methanol vapor was reduced.

Acknowledgments: This research was funded by National Science Center, grant number 2019/35/B/NZ7/01165.

New nanoformulations of cannabidiol, celecoxib, and 2,5-dimethylcelecoxib impact the survival of glioblastoma cells

Authors: Anna Rybarczyk1, Aleksandra Majchrzak-Celińska1, Ludwika Piwowarczyk2, Violetta Krajka-Kuźniak1
Affiliation: "1Department of Pharmaceutical Biochemistry, Poznan University of Medical Sciences, Rokietnicka 3, 60-806 Poznan, Poland
2Department of Pharmaceutical Chemistry, Poznan University of Medical Sciences, Rokietnicka 3, 60-806 Poznan, Poland"
Tutor: Prof., Ph.D., Violetta Krajka-Kuźniak1; Assoc. Prof., Ph.D., Aleksandra Majchrzak-Celińska1;

Introduction: In glioblastoma multiforme (GBM), the highest-grade IV glioma, the current standard treatment strategy is not effective. Exploring novel therapeutic options has become one of the approaches to increase the patient's overall survival. The use of nanocarriers, such as liposomes, may help overcome some limitations associated with chemotherapy including toxicity to healthy cells. Cannabidiol (CBD), naturally occurring in Cannabis sativa, as well as a synthetic anti-inflammatory drug celecoxib, have demonstrated potential anti-cancer properties. This constitutes a reason to investigate them as anti-GBM agents.

The aim of the study: The purpose of the study was to assess the cytotoxicity of liposome-loaded CBD, celecoxib, 2,5-dimethylcelecoxib (2,5-DMC), and their combinations on the GBM U-138 MG line. The potential toxicity towards human healthy astrocytes was also evaluated.

Methods: Small unilamellar/large unilamellar vesicle (SUV/LUV) liposomes were prepared using the dry lipid film method, followed by sonication and extrusion to unify the particle size. The glioblastoma U-138 MG cell line and human astrocyte (HA) cell lines were treated and incubated with these formulations within a concentration range of 1-50 μM for 48 hours, while the MTT assay was used to evaluate cellular viability.

Results: Our results revealed that after 48 h incubation all tested nanoformulations influenced cell survival of U-138 MG cells in a dose-dependent manner. Importantly, the dual-loaded liposomes (CBD + celecoxib and CBD + 2,5-DMC) did not exhibit improved cytotoxicity. Regarding the impact of the tested liposomes on healthy astrocytes, we also observed dose-dependent cytotoxicity, however the impact of empty liposomes on healthy astrocytes was marginal.

Conclusions: This preliminary study showed a cytotoxic effect of CBD, celecoxib, and 2,5-DMC-loaded liposomes in both malignant GBM cells and healthy astrocytes. Thus, in further studies, the applied doses should be cautiously chosen. We did not observe the synergistic effect of the treatment with dual-loaded liposomes, however additional research is needed to evaluate the lack of potential benefits of using CBD and celecoxib or CBD and 2,5-DMC in anti-GBM treatment.

Acknowledgments: This work was funded by grant no. 2021/43/O/NZ5/02346 from the National Science Centre, Poland.

Quaternary lidocaine derivatives as new APIs showing antimicrobial activity

Authors: Adriana Olejniczak, Witold Stachowiak, Michał Niemczak
Affiliation: Politechnika Poznańska, Wydział Technologii Chemicznej, ul. Berdychowo 4, 60-965 Poznań
Tutor: Michał Niemczak, Ph.D., Assoc. Prof.

Introduction: Currently, the most popular anesthetic drug is lidocaine – synthetic chemical compound from the amide group. Due to its short duration of action, it requires repeated applications. Exploring the properties of lidocaine by derivatizing it and combining it with a 2-furoic anion, which exhibits bactericidal activity, could lead to formation of new multifunctional active pharmaceutical ingredients (APIs).

The aim of the study: The aim of the study was to synthesize novel APIs consisting of bromide or 2-furoic anion and cation representing quaternary lidocaine derivatives containing 2 and 14 carbon atoms in the alkyl chain. It was planned to determine their antimicrobial activity and ecotoxicological profile.

Methods: The desired compounds were obtained via quaternization of lidocaine with appropriate alkyl halide and subsequent ion exchange reaction. The structures of the products were confirmed by spectroscopic techniques and the water content was measured according to the Karl Fisher method. MIC and MBC parameters were determined against Staphylococcus aureus. Eventually, the ecotoxicological profile was assessed towards Artemia franciscana and Chlorella vulgaris and analyzed in accordance to the Global Harmonized System (GHS).

Results: Spectral analysis confirmed the purity of the substances, and studies of physicochemical properties showed an increase in hydrophobicity with alkyl chain elongation. N-tetradecyllidocaine, was classified into category I acute aquatic toxicity towards green algae, while in the case of impact on Artemia fransicana it was assigned into II acute aquatic toxicity. Interestingly, N-ethyllidocaine turned out to be safe to all of the aquatic organisms. The presence of the 2-furoic anion does not increase the compounds' toxicity in any case. The obtained APIs proved to be effective inhibitors of Staphylococcus aureus growth.

Conclusions: The performed research revealed high application potential of the newly obtained lidocaine derivatives. Products' low environmental impact combined with simultaneous favorable antimicrobial and anesthetic properties will allow them to be implemented as an active ingredients in ointments and emulsions.

Acknowledgments: The research was funded by the Ministry of Education and Science (0912/SBAD/2309).

Soluplus-based micelles as a carrier for substances extracted from the bark of Magnoliae officinalis

Authors: Katarzyna Dominiak, Natalia Woźniak
Affiliation: Department of Pharmaceutical Chemistry, Poznan University of Medical Sciences, Rokietnicka 3, 60-780 Poznań, Poland
Tutor: dr hab. Maciej Stawny

Introduction: Soluplus is an amphiphilic copolymer of polyethylene glycol, polyvinylcaprolactam, and polyvinyl acetate. It has very good physicochemical properties and is safe to use. It is, therefore, often used alone or in combination with other polymers to obtain micelles.

The aim of the study: Soluplus was used to obtain polymeric micelles with honokiol and magnolol extracted from the bark of Magnoliae officinalis, and the preparation process was optimized using a Box-Behnken model.

Methods: Soluplus and honokiol, or magnolol, were dissolved in ethanol to obtain appropriate concentrations of both substances. The solvent was evaporated, and the resulting film was hydrated with distilled water. Evaluation of the micelles included measurement of particle size, zeta potential, pH, and osmolarity. HPLC and FT-IR allowed the assessment of lignans incorporation. Optimization of the process was carried out through a Box-Behnken model. In addition, the stability of the polymeric micelles was determined.

Results: The solvent evaporation method was suitable for obtaining polymeric micelles for both substances. The physicochemical properties depended on Soluplus concentration, lignans concentration, and total sample volume. In the case of micelles with honokiol, the statistical model allowed optimization in terms of mean particle size, zeta potential, osmolarity, percentage of honokiol loading into the polymer matrix, and polydispersity index before lyophilization. While for micelles with magnolol Box-Behnken model enabled optimization of the process in terms of osmolarity, zeta potential, and encapsulation efficiency. The honokiol micelles were stable for 15 days at 5°C.

Conclusions: Soluplus proved to be a suitable polymer to obtain stable micelles with appropriate physicochemical properties. The Box-Behnken model allowed for the optimization of the process.

Acknowledgments: This work was funded by grant OPUS no. 2022/45/B/NZ7/01056 from the National Science Centre, Poland.

Synthesis and Characterization of Curcuminoids with Anticancer Potential Against Bladder Cancer Cells

Authors: Pawel Bakun[1,3], Paulina Kobylka[2,3], Dariusz T. Mlynarczyk[1], Malgorzata Kucinska[2], Tomasz Koczorowski[1], Marek Murias[2], Tomasz Goslinski[1]
Affiliation:
1. Chair and Department of Chemical Technology of Drugs, Poznan University of Medical Sciences, Rokietnicka 3, 60-806 Poznan, Poland
2. Chair and Department of Toxicology, Poznan University of Medical Sciences,
Rokietnicka 3, 60-806 Poznan, Poland
3. Doctoral School, Poznan University of Medical Sciences, Bukowska 70, 60-812 Poznan, Poland

Introduction: Cancers constitute an important problem despite the development of medical and pharmaceutical sciences. Bladder cancers cause nearly 200,000 deaths annually worldwide, which represents 2.1% of all cancer deaths. Curcumin reveals interesting antineoplastic activity that could help in the treatment of cancer. Unfortunately, it has some limitations which prevent its application in medicine, namely, poor water solubility, low stability, and unsatisfactory bioavailability.

The aim of the study: The aim of the presented research was to synthesize curcuminoids capable of decreasing the survival rate of bladder cancer cells in vitro. Considering that the selected pharmacokinetic parameters of curcumin are not satisfactory, it was planned to obtain derivatives with improved physicochemical properties.

Methods: As part of the research, both classical and microwave methods of chemical synthesis were used. The obtained derivatives were characterized by the following techniques: NMR, HR-MS (ESI), and UV-Vis. In addition, in vitro tests on eukaryotic (5637, SCABER, MRC-5) and prokaryotic (Aliivibrio fischeri) cell lines were performed to evaluate the cytotoxicity of curcuminoids.

Results: The conducted research involved the synthesis and characterization of nearly 40 compounds. Among them, eight molecules showed significantly improved anti-cancer effects than the reference compound – curcumin. The most active derivatives reached an IC50 inhibitory concentration of about 1 µM in the MTT viability assay after 48 hours of incubation.

Conclusions: In light of the conducted research, we conclude that the observed biological effects of the studied curcuminoids result primarily from improving their solubility in water. Further physicochemical and biological analysis is underway to elucidate the intracellular mechanisms of the most active molecules.

Acknowledgments: The study was performed thanks to financial support from the National Science Center Poland - grant no. 2019/35/B/NZ7/01165.

Titanium alloys modified with zeolites containing divalent ions and active substances - epigallocatechin gallate and tetracycline

Authors: mgr inż. Wiktoria Stachowicz
Affiliation: Faculty of Chemical Technology, Poznan University of Technology
Tutor: dr inż. Mariusz Sandomierski, dr hab. inż. Magdalena Regel-Rosocka, prof. PP

Introduction: Osteoporosis is the most common metabolic disease of the skeletal system, characterized by impaired bone strength. The disease is detected in an advanced stage, when pharmacological treatment does not bring the desired results and it is necessary to replace the weakened bone with an implant. The possibility of modifying the surface of materials used in tissue engineering, combined with the creation of delivery systems for therapeutic substances supporting osteoporosis therapy - epigallocatechin gallate (EGCG) and tetracycline, may constitute a new effective method of preventing the deterioration of bone tissue. From the point of view of the treatment of osteoporosis, it is interesting that the material for modification may be zeolite.

The aim of the study: The aim of the work is to determine the possibility of attaching active substances with properties that inhibit osteoclasts and improve osteointegration - epigallocatechin gallate (EGCG) and tetracycline - to the surface of titanium alloy Ti6Al4V, modified with zeolite containing divalent ions: Zn2+, Mg2+, Ca2+. The obtained coatings together with the attached active substances will be characterized using a number of techniques to determine the effectiveness of the alloy modification and adsorption process.

Methods: In order to obtain modified surfaces of Ti6Al4V titanium alloys, the material was abraded and cleaned. The samples were placed in 30% H2O2 and dried. The in situ hydrothermal method was used to produce zeolite coatings (using sodium aluminate, sodium hydroxide and sodium silicate). The obtained Na-Zeo-Ti6Al4V material was placed in appropriate chloride solutions for 24 hours: 0.5M ZnCl2, 0.5M MgCl2, 5M CaCl2. The process was repeated three times, and then the samples were cleaned and dried. The materials Zn-Zeo-Ti6Al4V, Mg-Zeo-Ti6Al4V and Ca-Zeo-Ti6Al4V were obtained. The sorption of drugs - EGCG and tetracyclines was carried out, and then the process of drug desorption from modified surfaces was observed under the influence of SBF - a simulated body fluid with a high concentration of Na+ ions and pH 7.4 and an acetate buffer with pH 5. The purpose of using two environments with different pH values is analyzing the release profile of EGCG and tetracycline in relation to the body's acid-base balance.

Results: SEM analysis confirmed the presence of zeolite structures and correct modification. No significant changes were noticed between the materials before and after the drug sorption process, which indicates that they were attached via ions and were not precipitated. Photos obtained using the EDS system made it possible to determine the distribution of zinc, magnesium and calcium ions after ion exchange, as well as the distribution of carbon and nitrogen, which come from the structures of adsorbed active substances. FT-IR analysis confirmed the presence of appropriate functional groups from the zeolite skeleton and the efficiency of EGCG and tetracycline sorption, as evidenced by the presence of new bands. The analysis of the changing concentration of solutions using a UV-Vis spectrophotometer, both during the sorption process and the release of active substances, made it possible to obtain graphs showing the amount attached and detached from

the samples in two environments with different pH values. The use of different environments influenced the desorption profile of the tested active substances. The release in SBF at pH 7.4 occurred gradually, and a small dose of the drug was released at given time intervals, which made the resulting profile take on a more gentle shape. The acidic environment, obtained thanks to the acetate buffer with pH 5, resulted in the release of a significant dose of medicinal substances in the first hours after the start of the process.

Conclusions: The use of two environments to carry out the release process allowed us to analyze the desorption profile in relation to the acid-base balance of the body. In pathological conditions associated with the accumulation of osteoclasts, contributing to a reduction in the physiologically normal pH, the release of a large dose of epigallocatechin gallate and tetracycline may contribute to the inhibition of the activity of a significant number of these cells. Under normal conditions, the regular release of small doses of active substances will influence osseointegration, proper regeneration of surrounding tissues and reduce the possibility of inflammation within the implant.

Acknowledgments: The research was funded by the Ministry of Education and Science, Poland, (grant No. 0912/SBAD/2310)

Synthesis and Characterization of Curcuminoids with Anticancer Potential Against Bladder Cancer Cells

Authors: Beata Drabińska, Jacek Kujawski
Affiliation: Poznan University of Medical Sciences, Faculty of Pharmacy, Chair and Department of Organic Chemistry, Rokietnicka 3 street, 60-806 Poznań, Poland
Tutor: Jacek Kujawski, Assoc. Prof., PhD

Introduction: Isavuconazole and ravuconazole are triazole derivatives with potent broad-spectrum antifungal activity including yeasts, dimorphic fungi and molds1,2. As the available data regarding their structure are limited, we wanted to fill this gap as a part of our investigation.

The aim of the study: The purpose of our investigation was to demonstrate what basis sets or method applied for spectra predictions would produce the most consistent results with the experimental data. Such a study might help to improve understanding of structural and spectral attributes responsible for biological function for analyzed compounds.

Methods: The initial structures of optimized rotamers of isavuconazole and ravuconazole were taken from the given in the crystallographic base CCDC or PubChem platform, and were named as follows: GALJUC (*.cif file) and PubChem CID 467825 file, respectively. They were initially optimized (Gaussian 16 A.03 program) using DFT formalism, namely: a) CAM, b) M062X, c) wB97XD functionals (6-31G(d,p)/CPCM). For UV-vis calculations we applied using TD-DFT method, the linear response (LR) approach (6-311++G(2d,3p approximation). Analysis was conducted in acetonitrile, chloroform, DMSO, methanol and n-hexane.

Results: Experimental UV studies are still ongoing, although λmax is in good agreement with data obtained from literature (285nm). On this account, the solvatochromic effect and the HOMO-LUMO descriptors related with the analyzed azoles were investigated. Our proposed methodology seems to be a potentially useful tool for prediction UV-vis properties of biologically active conazoles. We wish to investigate this standpoint further in the near future.

Conclusions: The highest correspondence to the experimental UV data was obtained using the CAM functionals for investigated conazoles.

Acknowledgments: The calculations were supported by the NCN Miniatura project (2022/06/X/NZ7/00227).

References:

1. Pfaller,M.A, et al., Antifungal Activities of Posaconazole, Ravuconazole, and Voriconazole Compared to Those of Itraconazole and Amphotericin B against 239 Clinical Isolates of Aspergillus spp. and Other Filamentous Fungi: Report from SENTRY Antimicrobial Surveillance Program. ASM Journals, 2002, 46 (4), 1032-1037

2. Elisworth M., Istrosky-Zeichner L., Isavuconazole: Mechanism of Action, Clinical Efficacy, and Resistance. Journal of Fungi, 2020, 6 (4): 324

SPONSORS'

AND

VISITING ABSTRACTS

Application of cyclodextrin polymers in gene therapy

Authors: Ágnes Rusznyák
Affiliation: Department of Molecular and Nanopharmaceutics, University of Debrecen

Introduction: Nowadays, RNA-based therapies play an increasingly important role in the treatment of various diseases. Due to the large molecular size and polyanionic nature of RNA, it is difficult to transfect into cells [1]. To solve this problem, many carrier systems are under development or available, which are usually based on liposomes or polymers. Cyclodextrins are widely used excipients to increase the solubility and bioavailability of lipophilic molecules, but some of their polymer derivatives are also able to deliver macromolecules.

The aim of the study: In our work, we aimed to investigate the siRNA and mRNA carrying capacity of cyclodextrin polymers, to examine the effect of the formulated polyplexes on gene silencing or expression, as well as the properties and cellular internalization of the polyplexes.

Methods: The effect of different polymer solutions on cell proliferation was measured by RTCA method on Caco-2 cells. The properties of the formulated polyplexes were investigated by dynamic light scattering technology (DLS) and zeta potential measurements. The cellular internalization of the polyplexes was investigated by confocal microscopy and flow cytometry, while their intracellular effects were investigated by fluorescence microscopy.

Conclusions: In conclusion, we have successfully formulated cyclodextrin polymer-based RNA delivery systems. Polyplexes formulated with different polymers showed different cellular internalization. Polyplexes formulated with Q polymer were taken up by cells and influence the expression of α-tubulin protein.

Acknowledgments: Project no. TKP2021-EGA-19 has been implemented with the support provided by the Ministry of Culture and Innovation of Hungary from the National Research, Development and Innovation Fund, financed under the TKP2021-EGA funding scheme.

Formulation and evaluation of transdermal patches containing the drug candidate BGP-15

Authors: Ildikó Bácskay, Zsolt Hosszú, Dóra Kósa, Ádám Haimhoffer, Ágota Pető
Affiliation: University of Debrecen, Faculty of Pharmacy, Department of Pharmaceutical Technology

Introduction: BGP-15 is a Hungarian developed active ingredient with many advantages like beneficial cardiovascular and anti-inflammatory effect. The transdermal administration of BGP-15 has great potential, which has not been investigated yet, despite the fact that it is a non-invasive and safe form of treatment with high patient compliance.

The aim of the study: The purpose of our study was to formulate transdermal patches containing BGP-15 and optimize the production with Box-Behnken design of experiment in terms of drying time, polymer, and solvent proportion.

Methods: Moreover, tensile strength, moisture content and moisture uptake of the patches were tested. The most optimal formulation was further combined with penetration enhancers to improve bioavailability of the active ingredient and in vitro drug release and in vitro permeation of BGP-15 from the patches were investigated by Franz diffusion chamber apparatus. FTIR spectra of the formulations and the components were also studied, FTIR spectrum of BGP-15 is described for the first time in scientific literature.

Results: The most optimal formulation based on the tested parameters is dried for 24 hours, with 67% polyvinyl alcohol (PVA) content and low ethanol content. The bioavailability of BGP-15 was most significantly enhanced by the combination of Transcutol and Labrasol.

Conclusions: With the most optimal composition we were able to further enhance the bioavailability of BGP-15 and confirm the compatibility of the vehicle and the active substance by FTIR and SEM. In the in vitro tests of drug release and permeation we confirmed that the formulation is suitable for the transdermal delivery of BGP-15.

Acknowledgments: This research was supported by the ÚNKP-22-4-I National Excellence Program of the Ministry for Innovation and Technology from the source of the National Research, Development and Innovation Fund. Project no. TKP2021-EGA-19 has been implemented with the support provided by the Ministry of Culture and Innovation of Hungary from the National Research, Development and Innovation Fund, financed under the TKP2021-EGA funding scheme. The publication was supported by the GINOP-2.3.1-20-2020-00004 and GINOP-2.3.4-15-2016-00002 projects. The project was co-financed by the European Union and the European Regional Development Fund.

Novel Self-Nanoemulsifying Drug Delivery System Containing Curcumin for Topical Skin Delivery

Authors: Liza Józsa, Gábor Vasvári, Ágota Pető, Ildikó Bácskay, Pálma Fehér
Affiliation: University of Debrecen, Faculty of Pharmacy, Department of Pharmaceutical Technology

---

Introduction: Curcuma longa has been used both externally and internally for decades due to its beneficial effects on health and low toxicity. The polyphenolic compound called curcumin - which is the main active ingredient of the plant - can be isolated from the rhizome of the turmeric. Based on literature, curcumin can be promising in the treatment of various clinical symptoms, as it is associated with significant anti-inflammatory and antioxidant activities. It also can exhibit beneficial effects in wound healing and prevention of chronic ultraviolet B (UVB) damage. Despite these positive effects, a major criticism of curcumin is its poor bioavailability. According to the Biopharmaceutical Classification System (BCS), it belongs to the group IV, which means that it shows very low water-solubility and permeability. Therefore, the in vivo effectiveness of curcumin is usually limited in aqueous solution.

The aim of the study: This study was aimed to design topical dosage forms containing curcumin in self-nanoemulsifying drug delivery system (SNEDDS) and to evaluate their in vitro and in anti-inflammatory and antioxidant effect.

Methods: "First of all, solubility and emulsification efficiency studies were carried to identify the suitable SNEDDS components. By the construction of the pseudoternary phase diagrams, the quantities of oil phase, surfactant and co-surfactant in appropriate portions was determined. Self-nanoemulsifying drug delivery systems (SNEDDS) were developed by mixing the selected surfactant (Labrasol) and co-surfactant (Transcutol P) in 1:1 ratio and then isopropyl myristate (IPM) was added as the oil phase. The given concentration of curcumin was dissolved in the mixture.
A dynamic light scattering (DLS) device was used to determine the droplet size of the dispersed phase. The electrostatic potential of the double layer surrounding the droplets was also measured with Zetasizer Nano S equipment. With the investigation of the zeta potential, the stability of the self-emulsifying systems were determined. The samples were freshly diluted with 100 mL distilled water and analyzed in triplicate in all measurements. The drug loading efficiency and the thermodynamic stability of the SNEDDS were also determined. The cytotoxic effects of the formulations were examined by the MTT assay on human keratinocyte (HaCaT) cell line. The direct radical scavenging activity was investigated by 2,2-diphenyl-1-picrylhydrazyl (DPPH) method, while indirect antioxidant capacity was determined by the measurement of the superoxide dismutase enzyme level on HaCaT cell after the treatment. To investigate the anti-inflammatory effect of the curcumin containing SNEDDS, ELISA tests were performed on HaCaT cell line.
Curcumin containing creams and gels were formulated using two different emulsifiers and two different gelling agents as well. To determine the release rate of curcumin from the creams and gels permeation studies were performed by Franz vertical diffusion cells. Anti-inflammatory activity was measured using carrageenan-induced rat paw edema assay. The level of the inflammation induced by UV radiation after pretreatment was also determined on rats."

Results: It was found that the most dominant factor which influenced the area of the nano-emulsion existing zone was the amount of the oily phase. According to the results the nano-emulsion existing zone was the largest in case of the composition prepared with Labrasol - Transcutol P – IPM mixture in the same proportions. The DLS measurement verified that the higher oil content resulted in larger particle size. Although the droplet size increased with the incorporation of the active ingredient, the polydispersity index (PDI) remained unchanged, indicating a homogeneous size distribution. Our formulations were characterized by slightly negative zeta potential, which was due to the use of nonionic surfactants. However, during the thermodynamic stability testing, no precipitation, creaming, cracking or phase-separation was observed, and these results overall suggest acceptable stability. The drug loading efficiency for formulations was found in the range of 93.11% to 99.12%. It was also observed that compositions with a higher concentration of oily phase possess a higher capacity to solubilize curcumin. In our study the cytotoxicity of 1, 5, 10 w/v% solutions of the formulated SNEDDS was determined. It was found that compositions formulated with Labrasol were better tolerated by both cell lines. The measured cell viabilities were higher than 70%, even when cells were treated with the 10 w/v% solution. SOD activity of HaCaT cells was monitored after the treatment with the different SNEDDS compositions. Treatment with Labrasol containing compositions caused a significantly higher SOD level. The results showed that curcumin had higher radical scavenging activity when it was incorporated to a SNEDDS. This study demonstrated that treatments with creams and gels containing curcumin incorporated in SNEDDS significantly reduced the level of TNF-α and IL-1β investigated on HaCaT cell line. The anti-inflammatory effect was also supported by in vivo experiments.

Conclusions: According to the experiments, our formulations had high thermodynamic stability, and drug loading efficiency. All preparations greatly enhanced the anti-inflammatory effect of curcumin on HaCaT cells as well as its antioxidant capacity while maintaining acceptable cell viability. Thus, the formulation of curcumin into SNEDSS could be a promising approach for overcoming the solubility and bioavailability problems related to this highly lipophilic drug.

Acknowledgments: This research was supported by the ÚNKP-22-4 New National Excellence Program of the Ministry for Innovation and Technology from the source of the National Research, Development and Innovation Fund. Project no. TKP2021-EGA-18 has been implemented with the support provided from the National Research, Development and Innovation Fund of Hungary, financed under the TKP2021-EGA funding scheme. The publication was supported by the GINOP-2.3.1-20-2020-00004 and NKFI-143360 projects. The project was co-financed by the European Union and the European Regional Development Fund.

Physicochemical properties of acid-soluble collagen extracted from silver carp skin

Authors: Martyna Nyga, Hanna Wosicka-Frąckowiak, Stanisław Woźny, Kornelia Poniedziałek
Affiliation: GENERICA R&D Lab, Regionalne Centrum Zdrowia Sp. z o.o., 3 Na Kępie St., 64-360 Zbąszyń, Poland
Tutor: Bartłomiej Milanowski, PhD, MPharm

Introduction: Collagen is the most abundant protein in our body, comprising approximately 30% of the total protein content. Collagen and its hydrolysates have broad applications in many fields, such as food, pharmaceutical, cosmetic, biomedical materials, photographic and leather industries.
Twenty-eight types of collagen have been reported so far, but about 85% of the dermal collagen is type I, which represents the fibrillar collagens. The molecular structure of collagen is defined by three polypeptide α-chains forming a right-handed triple helix.
Porcine and bovine collagen sources have been the most popular so far. However, bovine spongiform encephalopathy (BSE) and transmissible spongiform encephalopathy (TSE) still create anxiety, which may clear the way for fish collagen. Although marine collagen's physical and chemical properties may differ from mammalian ones, fish collagen is unlikely to cause BSE or TSE and is not forbidden for religious reasons. Moreover, fish skin is a huge byproduct of fishery processing worldwide and its utilization as a source of collagen seems a decent choice.

The aim of the study: Determination of the physicochemical properties of acid-soluble collagen extracted from silver carp skin

Methods: All reagents were of analytical grade. Purified Type I Bovine Collagen Solution 3 mg/mL (TeloCol®-3, Advanced BioMatrix) was purchased from CellSystems GmbH, Germany.
Collagen gel was obtained from the defrosted and prepared skin of silver carp (Hypophthalmichthys molitrix) by the in-house acid extraction process yielding a telopeptide-intact collagen. After that, the telocollagen gel was purified by multistage filtration.
The final product (~ 100 L) was characterized with different techniques, including organoleptic, pH, conductivity, viscosity, weight loss on drying, identity by SDS-polyacrylamide gel electrophoresis (SDS-PAGE), protein content by biuret assay, nativity and agglomerate content using size exclusion chromatography with UV detection (SEC-UV), lactic acid content using HPLC-UV method, microbiological purity and long-term stability.

Results: An acid-soluble collagen extracted from silver carp skin was in the form of a light grey gel with a characteristic fishy smell and smooth, homogenous structure without lumps and mechanical impurities The physicochemical properties were as follows: pH (Ph. Eur., 2.2.3) value of gel was 3.0, the conductivity (Ph. Eur., 2.2.38) 103 mS/m, viscosity 25760 mPas, weight loss on drying (gravimetrically) 97.2 %. The SDS-PAGE revealed characteristic bands around 150, 125, and 118 kDa. The protein content (quantified using biuret assay) was 3.0 %, while the lactic acid content (quantified using the HPLC-UV method) was 0.9% w/w. The nativity (triple helical structure) was confirmed using the SEC-UV method (compliance of the tested sample's retention times with the collagen type I standard). Moreover, the gel fulfilled Ph. Eur., 5.1.4 criteria of microbiological purity of

topical dosage forms (TAMC <10 CFU/g, TYMC <10 CFU/g, lack of P. aeruginosa and S. aureus). A long-term stability study confirmed the gel was stable for at least 36 months while stored at 5±3 °C.

Conclusions: Acid-soluble collagen from the skin of silver carp was isolated and purified and some properties of this product were investigated. SDS-PAGE patterns showed it was type I collagen. SEC-UV indicated that the collagen was in its native form (triple helix). The protein content in the gel was around 3% and the product met the criteria of microbiological purity. In addition, it was stable for 36 months when stored at a temperature 5±3 °C.

Acknowledgments: The authors are grateful for the financial support received within the Polish National Centre for Research and Development grant number POIR. 01.01.01-00-1004/18.

Student Oral Presentation Awards

1st: Thermal behaviour and stability of the spray-dried co-amorphous carvedilolphosphate-lovastatin system by Agata Olszewska

2nd: The effect of dissolution media on the combined dissolution/permeation behavior of fenofibrate solid dispersion in mixed phospholipid/polymer matrices by Aleksandra Słaba

3rd: Heteroleptic zinc(II) aza-dipyrromethene complexes - Synthesis and spectral properties by Milena Kasprzak

3rd: Bioavailability enhancement of herbal compounds: cyclodextrin complexation study of diarylheptanoids by Tymon Yu

PhD Student Oral Presentation Awards

1st: Formulation of microfibers containing modified release omeprazole by triaxial electrospinning method by Justyna Srebro

2nd: Introduction of "green chemistry" principles into the synthetic pathway of dibromo- and tetrabromocurcuminoids with potential antimicrobial activity by Eduard Potapskyi

3rd: DNA Under Fire: Evaluation of Double and Triple Combinations of Cisplatin, Olaparib, and KDM Inhibitors in a Head and Neck Cancer Model by Dawid Dorna

Acknowledgment: Chemical tool for imaging changes in the cellular environment - fluorescent molecular probe by Piotr Michałowski

Student Poster Session Award

Preliminary studies on a microneedle system with protoporphyrin IX of potential use in the treatment of skin cancer by Agata Roszak

PhD Student Poster Session Award

Titanium alloys modified with zeolites containing divalent ions and active substances - epigallocatechin gallate and tetracycline by Wiktoria Stachowicz