FACULTY OF PHARMACY WITH LABORATORY MEDICINE DIVISION

MASTER PROJECTS PROPOSALS FOR ERASMUS+ STUDENTS

ACADEMIC YEAR 2017/2018

Title

Muscarinic receptors expression in medial prefrontal cortex pyramidal neurons in young, adolescent, adult and aged rats

Department/Laboratory

Laboratory of Physiology and Pathology, Centre for Preclinical research and Technology

Supervisor

Maciej Gawlak, PhD

Short description

Small neurotransmitters acetylcholine, serotonin, adrenaline and dopamine modulate prefrontal cortex neuron activity and they are important for cognitive functions organism. The aim of the study is to examine expression of the muscarinic receptors in medial prefrontal cortex pyramidal neurons with immunofluorescence methods in confocal microscopy.

Title

Dendritic membrane potential control in medial prefrontal cortex (mPFC) pyramidal neurons by adrenergic receptors.

Department/Laboratory

Laboratory of Physiology and Pathology, Centre for Preclinical research and Technology

Supervisor

Katarzyna Grzelka, MSc

Short description

Impaired control of mPFC by adrenergic receptors occurs in many neuropsychiatric diseases, e.g. PTSD, ADHD, depression. The aim of the project is to examine which adrenergic receptors are responsible for the membrane potential changes in pyramidal neurons in the rat PFC. Using different methods of the patch-clamp technique, the problem will be studied at the level of dendrites.

Title

Kinetic properties of Nav1.1 ion channel bearing mutations identified in Dravet Syndrome

Department/Laboratory

Laboratory of Physiology and Pathology, Centre for Preclinical research and Technology

Supervisor

Ewa Nurowska, PhD

Short description

Epileptic syndromes caused by mutations of the *SCN1A* gene, encoding a subunit of the voltage-gated Na^+ ion channel ($Na_v1.1$), are heterogeneous and phenotypically different disorders. They encompass a spectrum that ranges from epilepsies with benign symptoms to catastrophic epileptic encephalopathies, like Dravet Syndrome. Until now a clear correlation between the type/location of the mutations and the clinical presentation of the syndrome has not been established, moreover in the most cases it is not known which functions of Na^+ channel are disturbed during the course of the disease.

The aim of the study is to investigate the relationship between the type of the *SCN1A* mutations and the voltage-gated Na^+ channels' dysfunctions. Selected mutations identified in Dravet Syndrome patients will be reconstructed in cDNA of *SCN1A* gene and expressed in HEK tsA201 cells. Voltage-dependent Na^+ currents in these cells will be investigated with the use of voltage-clamp technique.

Title

Scripting the prototype of virtual patient to support training of motivational interviewing skills

Department of Clinical Pharmacy and Pharmaceutical Care

Supervisor

Anna Dworakowska, PhD; prof. Malgorzata Kozlowska-Wojciechowska MD, PhD

Short Description

Motivational interviewing is an evidence-based intervention for influencing patient behaviors. The aim of the project is to write a script of virtual patient with the use of Edusimulations Internet platform. The simulation will be used among pharmacy students to support learning of motivational interviewing principles. Edusimulations is an Internet based platform for online learning in the e-advancement educational model. Edusimulations can be used as a tool for scripting and testing educational games.

Title

Online educational games as a tool to improve attitudes towards future collaboration between pharmacy and medical students

Department/Laboratory

Department of Clinical Pharmacy and Pharmaceutical Care

Supervisor

Anna Dworakowska, PhD

Short Description

Pharmacists and physicians in Poland are isolated in their interprofessional relationships. Interprofessional education seems to be an important factor that may enhance professional collaboration between pharmacists and physicians. The aim of the research is to script and test an online educational game for medical and pharmacy students to support interprofessional collaboration. In the next step, the aim would be to study the influence of this simulation on the actual attitudes of pharmacy and medical students with the use of the Scale of Attitudes Toward Physician-Pharmacist Collaboration (SATP2C).

Title

Systematic review and clinical analysis case study

Department/Laboratory

Department of Pharmacoeconomics

Supervisor

Anna Zawada M.Sc., Director of the Office of Transparency & Tariff Councils, Agency for Health Technology Assessment and Tariff System (AOTMiT), Tomasz Hermanowski, Ph. D, Head of Department, Assoc. Prof., Medical University of Warsaw

Short Description

Health Technology Assessment (HTA) is a recognised tool to provide the evidence needed for reimbursement decisions (see eg. Directive 2011/24/EU of 9.03.2011 on the application of patients' rights in cross-border healthcare). Thus HTA should be implemented in every EU Member State, Norway and Iceland. In Poland the Agency for Health Technology Assessment and Tariff System (AOTMiT) is a public institution advising the Minister of Health on the reimbursement of health technologies: drugs, medical devices and procedures. Analytical stuff assesses clinical and economic effectiveness of health technologies based on systematic review (SR), thorough methodology for gathering all evidence relevant to the research question. One Erasmus student interested in HTA, preferable having the basic knowledge on HTA, with fluent English reading/writing to be able to write a part of the HTA report in English, is welcome for an internship in AOTMiT where he/she will learn on the role of HTA in health care systems and how to perform SR and shape a clinical effectiveness analysis. The internship student will be equipped with all materials needed to perform SR.

Of note: According to confidentiality issues a technology for the assessment will be one not a subject to submission (as by the Act on reimbursement par. 35). Student will not get any payment (the issue of basic insurance to be cleared).

Title

Can oleacein prevent switch of VSMC to macrophage-like phenotype

Department/Laboratory

Department of Pharmacognosy and Molecular Basis of Phytotherapy

Supervisors

Andrzej Parzonko, PhD/prof. Marek Naruszewicz

Short Description

The aim of the project is to test the hypothesis that oleacein, polyphenolic component of olive oil, may stabilize atherosclerotic plaque by inhibiting pathogenic changes in vascular smooth muscle cells (VSMCs) caused by both oxidative stress and inflammation. Under the influence of cholesterol, oxidized phospholipids and platelet-derived growth factor, VSMC phenotype changes and becomes pro-atherosclerotic. The study will be performed in a cellular model using human VSMC lines and applying molecular methods. In this research it will be examined the dose-dependent effect of oleacein on VSMCs phenotype changes, with a focus on transdifferentiation to macrophage-like cells. VSMC will be incubated in the presence of free cholesterol, oxLDL or oxidized phospholipid, such as lysophosphatidylcholine. To confirm the phenotype change, we will measure a macrophage marker CD68 expression and the changes in mRNA levels of the genes that characterize VSMCs.

Title

The comparison of the polyphenolic profile of lime flowers (Tiliae flos) using HPTLC methodology

Department/Laboratory

Department of Pharmacognosy and Molecular Basis of Phytotherapy

Supervisors

Sebastian Granica, Ph.D./Agnieszka Bazylko Ph.D

Short Description

Tiliae flos commonly known as lime flower or linden flower is a popular medicinal plat material used in the form of infusion to treat symptoms of common cold, such as sore throat, cough and fever. *Tiliae flos* has a monograph in the European Pharmacopoeia 8.0, which defines lime flower as whole dry flowers obtained from *Tilia plathyphyllos* L., *Tilia cordata* Mill., *Tilia x vulgaris* Hayne or their mixture. The major aim of the study is the in-depth comparison of the polyphenolic profile of lime flower obtained from pharmacopoeial *Tilia* species using HPTLC methodology.

The student will be able to learn state-of-the-art analytical technique using modern devices available in the Department of Pharmacognosy. The expected result is to develop a fast and sensitive method allowing differentiation of extracts prepared from lime flowers obtained from different pharmacopoeial species.

The diploma thesis will be a part of the research project from Polish National Science Centre.

Title

Evaluation of antigenotoxic activity of *Oldelandia diffusa* extract and triterpenoid acids and determination of their cytotoxicity towards selected eukaryotic cells

Department/Laboratory

Department of Environmental Health Sciences

Supervisors

Anna Zgadzaj, Ramona Figat

Short Description

An increased occurrence of cancer is correlated with an increased human exposure to genotoxic agents. Therefore, there is the big need to identify new antigenotoxic agents able to decrease or remove the mutagenic effects. It is well established that medicinal plants are important source of active phytochemicals capable of preventing and repairing DNA damage.

The aim of the thesis is to evaluate antigenotoxic and cytotoxic activity of triterpenoid acids: oleanolic and ursolic acid and extract of *Oldenlandia diffusa* (Willd.) Roxb. *O. diffusa* is traditional Chinese medicinal plant from the *Rubiacea* family and contains high concentrations of triterpenoid acids.

The *umu*-test, a simple quantitative short-term bacterial assay, will be used for the detection of genotoxicity and antigenotoxicity. The assay is based on the detection of the SOS system induction in the strain *Salmonella typhimurium* TA1535/pSK1002. The antigenotoxic potential will be evaluated against the genotoxicity of known direct and indirect genotoxins in the absence and presence of metabolic activation with s9 fraction from rat's liver.

Additionally the cytotoxicity of tested triterpenoid acids and extract towards mammalian cell lines, V79 and Balb3T3, will be evaluated *in vitro* by neutral red uptake and MTT assay.

Title

Fullerene derivatives of nucleoside HIV reverse transcriptase inhibitors – *in silico* activity prediction

Department/Laboratory

Department of Drug Chemistry

Supervisors

Aleksander P. Mazurek D.Sc., Prof.; Monika Grudzień, Ph.D., Aleksandra Dąbrowska, M.Sc.

Short Description

The global epidemic directs virologists to understand the pathogenic processes caused by the virus, determine its structure, search for preventive vaccines, and for antiviral drugs. Knowledge of the viral enzymes responsible for replication of the virus (reverse transcriptase, protease, integrase) allows for synthesis and fast introduction into therapy of drugs which are inhibitors of these active proteins. Reverse

transcriptase inhibitors prevent the HIV enzyme reverse transcriptase (RT) from converting single-stranded HIV RNA into double stranded DNA. Nucleoside/nucleotide RT inhibitors (NRTIs) are faulty DNA building blocks that stop HIV DNA synthesis. Fullerene is an allotrope of carbon. Fullerenes research performed so far showed that some fullerene derivatives could inhibit the enzyme without cytotoxic effect. The fullerene derivatives should be considered as new chemical entities with new biological activity as a result of overall structure rather than composition of two subcomponents. The *in silico* molecular modeling studies will be performed using both quantum-chemical methods for isolated molecules and molecular mechanics based methodology for docking studies into active site of the enzyme. The software that will be used is: current version of Gaussian, Spartan and Discovery Studio program packages.

Title

Molecularly imprinted materials to pharmaceutical analysis – synthesis and properties examination

Department/Laboratory

Department of Organic Chemistry

Supervisors

Piotr Luliński, PhD

Short Description

Advanced materials of prearranged properties are required to fulfill the demands of modern biomedical analysis. For such purpose novel and sophisticated polymers based on imprinting technology can be applied. Molecularly imprinted polymers (MIPs) are fabricated in the template-tailored synthesis which allows obtaining three-dimensional cavities in the polymer network after polymerization and template removal steps. Those materials have found application in the separation techniques mainly as highly selective sorbents in solid phase extraction of biomolecules. During the master's degree course student will be allowed to possess the knowledge and laboratory practice in the field of synthesis of MIPs, their physico-chemical characterization as well as their application in the separation of biomolecules important from biomedical point of view. Our team possesses years of experience in the synthesis and analysis of MIPs as well as our laboratory is fully equipped in the necessary tools for preparation and analytical evaluation of MIPs.

Title

Theoretical analysis of ADMET parameters for potential drug molecules

Department/Laboratory

Department of Organic Chemistry

Supervisors

Teresa Żołek, PhD

Short Description

The research for new pharmaceuticals *via* computer modeling is one of the key challenges in modern medicine. In this work, we propose a simulation strategy for the prediction of pharmacokinetics of drug candidates by using currently available software ADMET Predictor™ version 8.0 of Simulations Plus which is very effective tool for calculation of absorption, distribution, metabolism, excretion and toxicity (ADMET).

Title

Searching for new biologically active derivatives of hydroxycoumarins

Department/Laboratory

Department of Organic Chemistry

Supervisors

Kinga Ostrowska, PhD

Short Description

The students will carry out the synthetic modifications of coumarin scaffold. The identification of new compounds will be defined by NMR and FTIR spectroscopic analyses and their purity will be confirmed by MS method. The obtained novel coumarin derivatives will be assayed for anticancer and antimicrobial activity as well as for 5HT receptors' affinity. Structure- activity-relationship (SAR) will be discussed.

Title

Biosynthesis of immunoactive Selenium-containing polysaccharides in mycelial cultures of medicinal mushroom *Lentinula edodes* (Berk.) Pegler

Department/Laboratory

Department of Drug Technology and Pharmaceutical Biotechnology

Supervisors

Eliza Malinowska, PhD

Short Description

The objective of the proposed project is to use biotechnological methods for biosynthesis of not described in the scientific literature macromolecular compounds – □-glucans containing atoms of selenium introduced into their structure.

Designed Se-containing polysaccharides will be isolated from the mycelial cultures of *Lentinula edodes* cultivated in media enriched with selenium compounds. Described in the scientific literature mushroom-derived polysaccharides, especially □-glucans display anticancer activity which results from their immunostimulating properties. A trace element of fundamental importance to human health, selenium (Se), has been shown to possess an analogous function with respect to the immune system. The mechanism by which selenium exerts anticancer and

immunomodulating activity differs from that of *L. edodes* polysaccharide fractions, but a similar pharmacological effect suggests a possible synergism of these two agents.
The project is a continuation of the research conducted in Department of Drug Technology and Pharmaceutical Biotechnology of Medical University of Warsaw, supported by grant of the National Science Centre in Poland.

Title

Synthesis of new pyrrolo[1,2-a]pyrazines with potential anticonvulsant activity

Department/Laboratory

Department of Drug Technology and Pharmaceutical Biotechnology

Supervisors

Maciej Dawidowski, PhD

Short Description

The primary goal of the project is search for novel potential anticonvulsant agents. This will be done by structural modifications of (4*S*,8a*S*)-4-phenylperhydropyrrolo[1,2-*a*]pyrazine-1,3-dione (ADD408003). This compound was first synthesized in Chair and Department of Drug Technology and Pharmaceutical Biotechnology, Medical University of Warsaw. It exhibited high activity in animal models of epilepsy which was comparable to known AEDs[1]. Importantly, the compound suppressed pharmacoresistant seizures in CKM and mTLE models. We anticipate that adequate modifications of the chemical structure of ADD408003 would yield compounds with enhanced ADME/PK profile and *in vivo* antiseizure activity.
The project will involve design and execution of chemical pathways leading to a number of chiral ADD408003 derivatives. This will be done *inter alia* by using Ugi U-5C-4CR multicomponent reaction[2]. Finally, the compounds will be characterized (NMR, IR, MS) and assayed for the stereochemical purity (NMR, LC/MS).

[1]Dawidowski et al, *Eur. J. Med. Chem*. 46, (2011), 4859-4869
[2]Demharter et al, *Angew. Chem. Int. Ed.* **1996**, 35, 173-175

Title

Antioxidant and UV- protective properties of hydrogels with extracts from Aronia melanocarpa

Department/Laboratory

Department of Physical Chemistry

Supervisors

Katarzyna Zawada, PhD/Agnieszka Zielińska, PhD

Short Description

Hydrogels are a group of polymeric materials, the hydrophilic structure of which make them capable of holding large amounts of water in their cross-linked polymeric network. Hydrogels have received considerable attention in the last years, due to their wide range of applications, for example in pharmaceutical and cosmetic formulations. Aronia melanocarpa fruits are mainly known for its use as an antioxidant, and also for anti-inflammatory and antimutagenic properties. The aim of the research will be the determination of UV- protective and antioxidant properties of hydrogels with extracts from fruits of Aronia melanocarpa, with use of spectroscopic techniques, including electron paramagnetic resonance spectroscopy (EPR). The extracts will be prepared from fruits in different ripening stages, thus contain different composition of constituents.
Additionally, the stability of these formulations and the pharmaceutical (transdermal) availability of the extracts components will be assessed

Title

An exploration of the polymorphism of piracetam using periodic DFT calculations

Department/Laboratory

Department of Physical Chemistry

Supervisors

Łukasz Szeleszczuk, PhD

Short Descritpion

Piracetam (2-(2-oxopyrrolidin-1-yl)acetamide) is a commonly used nootropic drug which was found to exist in various polymorphic forms. Those forms differ significantly not only in their structural parameters but also possess different thermodynamic properties. Therefore the bioavailability and pharmacokinetic parameters of piracetam depends on the polymorphic form.
Density functional theory (DFT) calculations for periodic crystalline solids were found to be a powerful tool in the pharmaceutical research. When applied properly they can be used to credibly predict various properties of the drugs, including dissolution parameters and stability.
The main object of the study will focus on the application of the periodic DFT calculations (CASTEP) in the exploration of the polymorphism of piracetam. The goal will be to create the phase diagram for solid piracetam in order to predict its other possible polymorphs and the conditions needed to obtain them.

Title

Application of hybrid docking/3D QSAR approach in predict activity of pharmacologicaly active compounds.

Department/Laboratory

Department of Physical Chemistry

Supervisors

Dariusz Pisklak, PhD; Jakub Harwacki, MSc.

Short Descritpion

In silico approach is one of the modern methodologies in drug design. There are two main approaches which are used . One of them is based on docking of potential drugs into active site of protein, this methodology allows to determine the bioactive conformation of a ligand , but is poor in prediction of protein affinity. Alternative approach is based on the 3D QSAR model (COMFA, COMSIA) where the prediction of potential activity is more reliable but the knowledge of the bioactive conformation is essential.
Aim of the study is to exploit the docking approach to obtain binding mode of the molecules , and by superimposing those conformation obtain a reliable 3D QSAR model for predicting the pharmacological activity. The molecular targets would be β adrenergic receptors which crystal structures are deposited in PDB database.

Title

Toll-like receptors expression in Graves-Basedow orbitopathy

Department/Laboratory

Department of Biochemistry and Pharmacogenomics, and Centre for Preclinical Research and Technology (CePT)

Supervisors

Prof. Grażyna Nowicka, PhD, DSc. and Dr Miroslaw Szczepanski, MD

Short Description

Background: Toll-like receptors (TLR) expressed on inflammatory cells play a key role in host defense against pathogens, benefiting the host. TLR are also expressed on other cells, including tumor cells, epithelial cells, endothelial cells, adipocytes or necrotic cells. Triggering of TLR induces inflammatory process.
Graves' disease, also known as toxic diffuse goiter, is an autoimmune disease that affects the thyroid. One of the symptoms of Grave's disease may include eye bulging, a condition caused by Grave's orbitopathy, and 30-80% of people with that condition develop eye problems.
The aim: of the study is to evaluate the expression and function of Toll-like receptors and other innate-immunity receptors in orbital adipose tissue and adipocyte cell line.
Material and methods:
Material: established human adipocyte cell lines and orbital adipocyte tissue obtained from patients underwent endoscopic orbital decompression due to Grave's disease.
Methods: in vitro cultures, qPCR, immunohistochemistry, flow cytometry, signaling.

Title

Modulation of IL-6 expression as a strategy for lung cancer treatment

Department/Laboratory

Department of Biochemistry and Pharmacogenomics, and Centre for Preclinical Research and Technology (CePT)

Supervisors

Prof. Grażyna Nowicka, PhD, DSc. and Dr Malgorzata Wrzosek, PhD

Short Description

Background: Lung cancer is one of the most common cancers in both men and women. Chemotherapeutic agents can not only induce tumor cell apoptosis but also trigger inflammation in the tumor microenvironment. Proinflammatory factors including IL-6 are involved in Multi Drug Resistance . It was shown that increased IL-6 production is associated with chemoresistance and poor prognosis.
The objective of this study is to evaluate the ability of selected herbal products to modulate IL-6 production induced by chemotherapeutics.
Materials and Methods.
Materials: A549 lung epithelial cell line, cisplatin and other chemotherapeutics, selected herbal products.
Methods: ELISA and immunochemistry to assess protein expression. qPCR to determine gene expression.

Title

Prevalence of antibiotic resistance genes in samples of surface water

Department/Laboratory

Department of Pharmaceutical Microbiology

Supervisors

Renata Wolinowska, PhD

Short Description

Multidrug-resistant bacteria are growing problem in global healthcare. Antibiotic resistance of microorganisms has been traditionally viewed as a clinical problem but it occurs in the environment naturally with environmental organisms as reservoirs of antibiotic resistance genes (ARGs). The aim of the project is to investigate the presence of selected ARGs in samples of surface water collected in places slightly contaminated by human activity. ARGs will be searched for in DNA isolated directly from water samples by PCR analysis or by cloning to plasmid vector and subsequent DNA sequencing. Results will be compared to these earlier obtained for water samples from Vistula river, collected in the neighborhood of Warsaw wastewater treatment plant. Though wastewater treatment technology purifies water, many antibiotic resistant bacteria, commensal and pathogenic ones, are released to receiving water and then spread throughout the environment.

Title

Development of a liquid chromatography/mass spectrometry screening methods for the identification and determination of active pharmaceutical ingrediencies in counterfeit medicinal products

Department/Laboratory

Department of Bioanalysis and Drug Analysis

Supervisors

Prof. Zbigniew Fijałek

Short Descritpion

Counterfeit medicines, imitations and substandard medicines are a growing problem worldwide. The problem is situated both in developing countries as in industrialized regions. In the developing countries the problem concerns the whole medicine supply chain, especially essential medicines like antibiotics, anti-malaria products. This is often due to the lack of effective enforcement agencies and the high prices of genuine medicines in these countries. In the industrialized world the problem concerns essentially life style drugs like the PDE-5 inhibitors, anabolic hormones and slimming products, although sometimes counterfeited antibiotics or insulin are intercepted by the customs. The growing threat of these products is mainly due to the extension of the internet, where about 50% of the medicines sold through internet sites disclosing their identity is estimated to be counterfeit.

To effectively fight against the counterfeiting of medicines appropriate analytical methods are needed.

Title

The investigations of phenolic compounds content and antioxidant activity of *Lithospermum canescens* (Boraginaceae) cultivated *in vitro*

Department/Laboratory

Department of Pharmaceutical Biology and Medicinal Plant Biotechnology

Supervisors

Katarzyna Sykłowska-Baranek, Assoc. Prof.

Short Description

Background: *Lithospermum canescens* is a common prairie plant also known as Indian paint or hoary puccoon. *L. canescens* grows from Saskatchewan to Georgia and West to Texas. Roots of this species contain red dye used by American Indians as face paint. Until now the phytochemical investigations of this species have been focused on shikonin derivatives and pyrrilizidine alkaloids presence. Phenolic compounds due to their antioxidant properties are known to inhibit of oxidative damage diseases such as coronary heart disease, stroke, and cancers.

Aim: The comparison of the culture conditions (medium composition and phytohormones) on phenolic compounds content and the antioxidant properties of plant extracts *Lithospermum canescens*.

Methods: The plantlets of *L. canescens* will be cultivated *in vitro* on various media supplemented with phytohormones to obtain abundant plant biomass. Phytochemical analysis will be performed to determine the total content of phenolic compounds by Folin-Ciocalteau method

and the HPLC-DAD technique will be developed for detection and quantification of phenolic acids: lithospermic, lithospermic B, rosmarinic, ferulic, caffeic and sinapic. The antioxidant properties of plant extracts will be determined using DPPH, ABTS and FRAP methods.

Title

Biotechnological and phytochemical experiments of *Echium plantagineum* L. *in vitro* root culture for the production of biologically active naphthoquinone derivatives

Department/Laboratory

Department of Pharmaceutical Biology and Medicinal Plant Biotechnology

Supervisors

Agnieszka Pietrosiuk, Assoc. Prof. , Małgorzata Jeziorek, MSc.

Short Description

Background: *Echium plantagineum* L. belongs to Boraginaceae family, known for the production of biologically active naphthoquinone derivatives of shikonin/alkannin type. Naphthoquinone compounds have been known for centuries because of wound healing properties and intensive red colour. Among other anticancer, antimicrobial or antiinfammatory activity of this group of compounds have been proven. New natural and synthetic structures of shikonin/alkannin type are constantly investigated as pharmaceutically very promising plant secondary metabolites. It has been reported that *E. plantagineum* roots can produce shikonin and several other naphthoquinone derivatives.

Aim: The aim of the study is to determine if *E. plantagineum in vitro* root cultures might be an efficient source of biologically active naphthoquinones.

Methods: The experiments will include biotechnological techniques for optimizing *E. plantagineum* root culture conditions and phytochemical investigation of collected plant material and post culture media.

Title

Synthesis and NMR characterization of lidocaine-containing ionic liquids for transdermal drug delivery

Department/Laboratory

Department of Inorganic and Analytical Chemistry

Supervisors

Prof. dr hab. Waclaw Kolodziejski

Short Description

Lidocaine is the most widely used local anesthetic. Injections of lidocaine are painful, so its transdermal administration can improve patient's comfort. A promising method to follow is to employ lidocaine-based ionic liquids (ILs). The ILs are salts, which are liquid well below 100 ^{o}C. For

the transdermal delivery one needs a lidocaine salt to be liquid at about room temperature. Such system comprising lidocaine cation and ibuprofen anion has recently been proposed and passed initial pharmaceutical tests (Park&Prausnitz, AIChE Journal 2015, 61, 2732-2738). That system and newly synthesized lidocaine ILs are to be studied using various techniques of liquid-state NMR. Interactions of such ILs with water and simulated body fluid (SBF) will also be examined. The proposed master task is a part of a broad, novel project to develop APIs in the IL form.

Title

Comparison of different mesoporous nano-composites, molecular sieve/hydroxyapatite for drug delivery with use of ibuprofen as a model drug

Department/Laboratory

Department of Inorganic and Analytical Chemistry

Supervisors

Łukasz Pajchel, PhD

Short Description

The aim of this work will be to prepare composites of molecular sieves SBA-15, MCM-41 and MCM-48 with the hydroxyapatite (HA) and deposition of ibuprofen on them. Then the release of the drug from these materials will be tested.

Hydroxyapatite is mineral part of animals hard tissue, so synthetic HA is widely used in medicine and dentistry because of its biocompatibility and bioactivity properties. In addition to the excellent biocompatibility of hydroxyapatite it also has an ability to adsorb and release of many molecules of great biological significance.

Highly ordered large pore mesoporous silica molecular sieves such as, SBA-15, MCM-41 and MCM-48 have difference morphology of the pores. The SBA-15 and MCM-41 is a silica material with a two-dimensional (2D) symmetry with pore diameter around 10 nm and 4 nm, and MCM-48 has a three-dimensional (3D) structure and pore diameter of about 10nm.

The molecular sieve/nano-HA/drug composite materials classified as DDS (Drug Delivery System) may be used not only as modern drug carriers but also as bone implants, where their role is twofold. They can be used as resorbable bone filling having similar mechanical properties, while releasing the drug at the same time.

In this work we obtain a molecular sieve/nano-HA/drug composite by synthesis of the hydroxyapatite on the commercial molecular sieve and depositing the ibuprofen onto the resulting composite.

The time and rate of release of the ibuprofen can indicate what influence have pore size and pore structure on the drug release from the molecular sieve/hydroxyapatite composite.

Title

Synthesis, characterization and application opportunities of the biodegradable, macromolecular drug conjugates

Department/Laboratory

Department of Biomaterials Chemistry

Supervisors

Ewa Oledzka PhD Eng.

Short Description

An interesting group of macromolecules applied in the production of materials for medicine and pharmacy are biodegradable polymers, used in endoprosthetics, controlled drug release, tissue engineering, etc. From the medical point of view of particular importance are polymers used in so-called therapeutic systems, dosing or releasing drugs with a programmed rate.

Therefore, the objective of this study is the synthesis, characterization (structural, physicochemical and biological) and application opportunities of the biodegradable, macromolecular drug-conjugates. The polymeric matrices will be synthesized from the heterocyclic monomers in the presence of natural initiators, whereas the macromolecular conjugates will be obtained by a covalent conjugation of the drug to the synthesized polymeric carriers. The influence of the topology of the obtained polymeric matrices, the microstructure of polymer chains on the biological properties as well as kinetics of hydrolytic and enzymatic degradation and the drug release profiles will be defined.

Title

The effect of selected trace elements on the expression of the MYC, IL-1, IL-6, TNF genes in the blood of rats with injected cancer cells

Department/Laboratory

Department of Bromatology

Supervisors

Barbara Bobrowska-Korczak, PhD

Short Description

Presently the researchers devote increasing attention to the role played by dietary minerals in the process of carcinogenesis. Many studies have been performed on this subject but a lot of results are nonhomogeneous, that is why practically no final conclusions could be drawn.

The aim of the research will be to evaluate the effect of selected trace elements (zinc, selenium, iron, copper and calcium) on the expression of the MYC, IL-1, IL-6, TNF genes in the blood of rats with injected prostate cancer cells (LnCaP).

The studies of selected genes will be carried out using the PCR and high-resolution melting (HRM) analysis.

Prevention is a promising option for the control of cancer.

Title

Evaluation of purine alkaloids contents in functional foods

Department/Laboratory
Department of Bromatology
Supervisors
Małgorzata Czerwonka, PhD
Short Description
Purine alkaloids are secondary metabolites derived from purine nucleotides that have been found in about 100 species of plants. The pharmacological effects of this compounds in animals, such as stimulation of the central nervous system, have been investigated extensively. Thanks to its properties are widely used in the pharmaceutical industry, as well as a functional additive in food products.
The analytical part of the work will include: (1) implementation, (2) the full validation of a RP-HPLC-UV method of selected purine alkaloids determination and (3) an evaluation of the content of these compounds (in particular caffeine) in functional foods available on the market. The descriptive part should include issues related to: the presence of purine alkaloids in the plant products, its metabolism and the mechanism of action (including toxicity), daily intake with the diet, legal aspects addition of these substances to food and its labeling, interactions between food containing a high content of purine alkaloids and some drugs.

Title
Health quality of fish oils available on the Polish market
Department/Laboratory
Department of Bromatology
Supervisors
Małgorzata Jelińska, PhD
Short Description
Fish oils are important dietary supplements frequently used by people all over the world. They contain n-3 polyunsaturated fatty acids (n-3 PUFA), including eicosatetraenoic (EPA) and docosahexaenoic acids (DHA), responsible for beneficial effects of oils for human health. However, rich in PUFA of many double bonds, fish oils are particularly susceptible to oxidation, which generates a number of harmful products (peroxides, aldehydes, etc.).
The aim of the work is to estimate the health quality of various fish oils available on the Polish market. Methods described in the European Pharmacopoeia will be used in the study (e.g. gas chromatography for EPA and DHA assessment).