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Book of Abstracts

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Wednesday 22. January 2020

Lecture hall A

Session 1 - Bioorganic and Pharmaceutical Chemistry: ***12:30 – 17:15***
Chairpersons: Prof. Danijel Kikelj, Prof. Pavel Kočovský, Prof. Petr Zimčík

BPC1

HOW TO NOT KILL MOSQUITO: CYSTEINE-TARGETED INSECTICIDES

GORECKI, L.,[1] ANDRYS, R.,[2] SCHMIDT, M.,[1,2] KUCERA, T.,[3] PSOTKA, M.,[1,2] SVOBODOVA, B.,[1,3] HRABCOVA, V.,[2,3] HEPNAROVA, V.,[1,3] BZONEK, P.,[2,3] JUN, D.,[1,3] KUCA, K.,[2] KORABECNY, J.,[1,3] MUSILEK, K.,[1,2]

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Acetylcholinesterase cysteine-targeted insecticides against malaria vector *Anopheles gambia* and other mosquitos have already been introduced. We have applied the olefin metathesis for the preparation of cysteine-targeted insecticides in high yields. The prepared compounds with
either a succinimide or maleimide moiety were evaluated on *Anopheles gambiae* and human acetylcholinesterase with relatively high irreversible inhibition of both enzymes but poor selectivity. The concept of cysteine binding was not proved by several methods, and poor stability was observed of the chosen most potent/selective compounds in a water/buffer environment. Thus, our findings do not support the proposed concept of cysteine-targeted selective insecticides for the prepared series of succinimide or maleimide compounds.

The study was supported by Ministry of Health of the Czech Republic (no. NV16-34390A), University of Hradec Kralove (no. SV2115-2018, no. VT2019-2021 and postdoctoral job positions at UHK), and University of Defence (Faculty of Military Health Sciences, Long-term development plan and SV/FVZ2019/01).

CYCLIZATION REACTIONS MEDIATED BY TRANSITION METALS

MATOUŠ, P.,[1] KADANÍK, M.,[1] MAŘÍKOVÁ, J.,[1] TIMORACKÝ, M.,[1] KUNEŠ, J.,[1] POUR, M.,[1]

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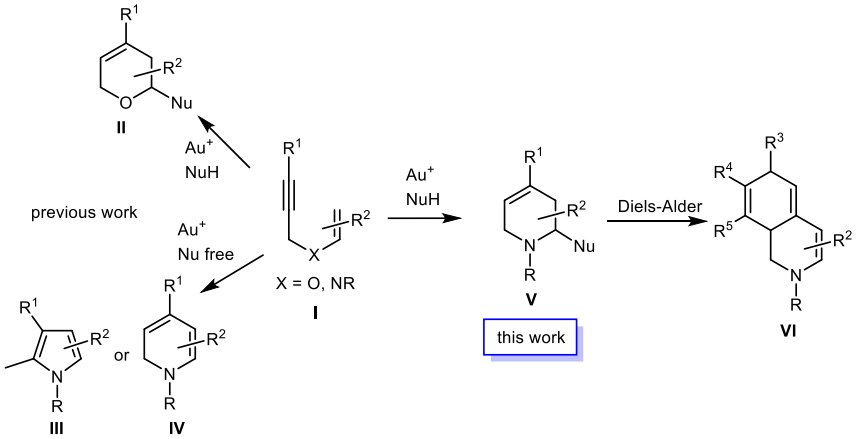
Synthesis of various types of heterocycles is possible from enyne precursors using cationic gold(I) species as catalysts. Our previous research on the cyclisation of propargyl vinyl ethers to dihydropyrans **II**[1] as well as chemoselective cyclizations of *β*-propargylamino acrylic esters to dihydropyridines **IV**[2] was extended to include nucleophile-assisted reactions.

The optimized synthetic protocol was applied to the preparation of a library of substituted tetrahydropyridines **V**. Their further transformations via i.e. cycloadditions gave highly substituted isoquinoline derivatives **VI**.



Scheme 1: Gold(I)-Catalyzed Synthesis of Piperidine Aminals

The study was supported by Charles University (GAUK 262416 and 1590119 and SVV 260 401) and Czech Science Foundation (Project No. 18-17868S).

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3 SAITO, A., KONISHI, T., HANZAWA, Y.: Org. Lett., 12, 2010, 372.

SYNTHESIS AND REACTIVITY OF ELECTRONICALLY TUNED [3]DENDRALENES

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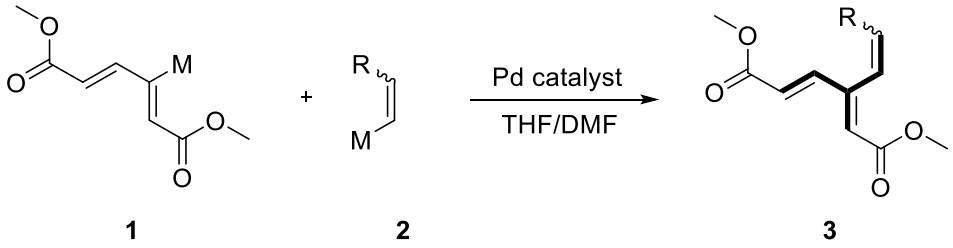
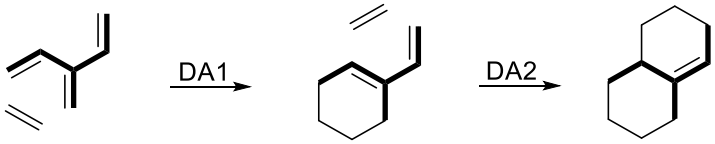
Dendralenes are acyclic cross-conjugated polyenes with an interesting, as yet unexamined reactivity and high potential for further synthesis.[1] We have focused on the synthesis of variously substituted electron poor [3]dendralenes containing electron withdrawing groups (e.g. carboxylic group), or a combination of electron withdrawing and donating groups. Synthesis is based on readily available *Z*-metallodienes **1**, which are subjected to Migita-Stille coupling[2] yielding the intended final products **3** (Scheme 1). Syntheses and possible applications of new compounds in domino Diels-Alder sequences (Scheme 2) will be discussed.



1 **2** **3**

Scheme 1: Migita-Stille coupling



Scheme 2: Diels-Alder reactions

The study was supported by Charles University (SVV 260 401, GAUK 1348119) and Czech Science Foundation (Project No. 18-17868S).

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UNUSUAL 1,3-IZOMERIZATION: PREPARATION OF POLYSUBSTITUTED PYRAN-2-ONES

BRŮŽA, Z.,[1] KRATOCHVIL, J.,[1] HARVEY, J. N.,[2] RULÍŠEK, L.,[3] NOVÁKOVÁ, L.,[1] KUNEŠ, J.,[1] KOČOVSKÝ, P.,[1,3,4] POUR, M.,[1]

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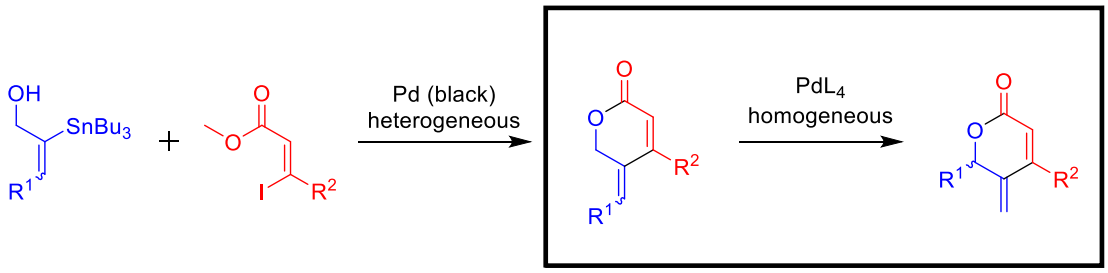
Originally discovered as minor by-products of our previous studies to the synthesis of disubstituted pyranones 1 (Scheme 1)1, we developed preparation of isomeric trisubstituted derivatives 22 into proper synthetic protocol. Having optimized the reaction conditions, we were able to prepare a broad library of compounds in high yields using mild conditions. In addition, our synthetic protocol showed high tolerance of functional groups. Screening of chiral ligands was also performed to probe the possibility of enantiocontrol over the newly introduced chiral centre.

We also performed quantum chemistry calculations in order to gain more insight into the mechanism of this transformation, which is seemingly unfavourable.



Scheme 1 General structures

The study was supported by Grant Agency of Charles University (project No. 1054216), Czech Science Foundation (project No. 18 17868S) and Faculty of Pharmacy in Hradec Kralove (SVV-260-401).

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1 Kratochvíl, J.; Novák Z.; Ghavre M.; Nováková L.; Růžička A.; Kuneš J.; Pour M. Org. Lett. 2015, 17, 520−523.

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PREPARATION, HPLC PURIFICATION, AND EVALUATION OF MODIFIED OLIGODEOXYNUCLEOTIDE PROBES

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Melting temperature difference between complementary and mismatched duplex has crucial role for discrimination of point mutations. Several oligodeoxynucleotide probes (ODNs) conjugated with melting temperature modifiers (acridine derivatives, modified Hoechst 33258) were prepared using copper-free click chemistry.[1] 13 and 18 bases long ODNs, containing one or two aza-dibenzocyclooctyne, were used. Modified ODNs were purified by zetadex gel filtration columns and HPLC. For HPLC purification PhenylHexyl column, triethylammonium acetate buffer (TEAA), and ACN in various ratios were used.[2] All samples were analysed using isocratic elution. Minor changes in ratio of TEAA and ACN were needed for optimization of elution times and resolution. Isocratic elution was used also for semipreparative HPLC. Two peaks were observed on all chromatograms (Figure 1). They were identified as constitutional isomers, and were taken together as one fraction. HPLC purified ODNs were tested for ability to increase melting temperature (Figure 2).

The study was supported by Technology Agency of the Czech Republic (060/860681) and The Charles University

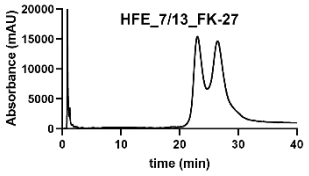

Figure 1 Chromatogram of probe modified by FK-27

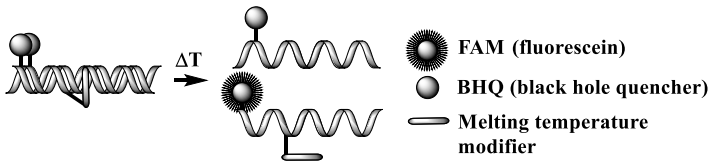

Figure 2 Scheme of hybridization study

Grant Agency (994218)

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BPC6

SYNTHESIS OF 1-AMINOADAMANTANE SUBSTITUTED PHTHALOCYANINES AND STUDYING THEIR SUPRAMOLECULAR COMPLEXES WITH CUCURBITURIL

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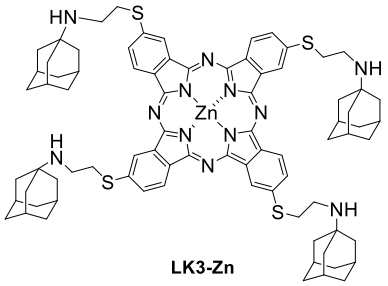
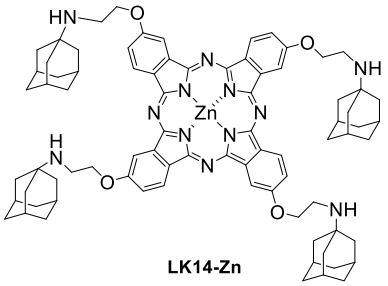
Phthalocyanines (Pc) are macrocyclic compounds with central metal cation. They can be used for example as dyes, pigments, catalysts or as photosensitizers in photodynamic therapy in cancer treatment. One big limitation of Pc is their poor solubility and aggregation in water. Cucurbiturils (CB) are pumpkin shape macromolecules composed of various number of glycoluril monomers.[1] They can bind guest molecules into their cavities. We used one of the strongest reported interaction between CB[7] and 1-aminoadamantane.[2] By creating a supramolecular complex of Pc and CB we should be able to improve solubility and aggregation of Pc in water. Three phthalonitrile precursors were prepared and after cyclotetramerization reactions two Pcs **LK3-Zn** and **LK14-Zn** with four peripherally 1-aminoadamantane substituents were synthesized. Photophysical properties of **LK3-Zn** were measured and were compared to its cucurbituril complex. Biological tests on HeLa cells showed ten times higher photodynamic activity of Pc-CB complex compared to Pc without CB.



LK3-Zn



LK14-Zn

The study was supported by SVV 260 401 and Grant Agency of Charles University (1606119).

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BPC7

ANIONIC AND CATIONIC PHTHALOCYANINES FOR PHOTODY-NAMIC THERAPY AND THEIR INTERACTION WITH BOVINE SERUM ALBUMIN

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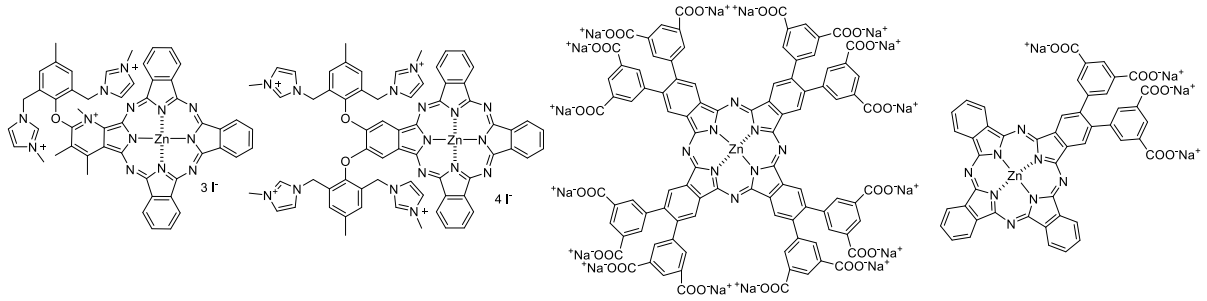
Phthalocyanines (Pcs) and their aza-analogues are macrocyclic compounds with interesting photophysical properties (strong absorption in area over 600 nm and strong singlet oxygen production) highly suitable for the use in photodynamic therapy of cancer. The aim of this work was synthesis and study of interaction of symmetrical and unsymmetrical anionic and cationic Pcs with bovine serum albumin and effect of this interaction on their photodynamic activity. Symmetrical Pcs were obtained by cyclotetramerization reaction (initiator magnesium butoxide) of one precursor while unsymmetrical Pcs were prepared by statistical condensation of phthalonitrile with 4,5-disubstituted phthalonitrile. Magnesium complexes were converted to metal-free ligands and then to zinc complexes. Basic hydrolysis of ester bonds was the last step of the synthesis of anionic Pcs. Quaternization of basic nitrogens was the last step of the synthesis of cationic Pcs. Pcs were tested on photodynamic activity in vitro on HeLa cells with different results in serum-free medium (SFM) and serum-containing medium (SCM). Effect of binding to serum proteins was studied as change in absorption and fluorescence spectra of Pcs after addition of bovine serum albumin. Obtained results corresponded well with change in photodynamic activity of these compounds in SFM and SCM.



The work was supported by Czech Science Foundation, grant. No. 19-14758Y and SVV 260 401

BPC8

SYNTHETIC AND BIOLOGICAL STUDY ON RHODANINE DERIVATIVES AND THEIR OXYGEN ISOSTERES

KUČEROVÁ-CHLUPÁČOVÁ, M.,[1] KONEČNÁ, K.,[2] NOVOTNÁ, S.,[2] DIEPOLTOVÁ, A.,[2] DUŠKOVÁ, A.,[1] JANĎOUREK, O.,[2] KUNEŠ, J.,[3] DOLEŽAL, M.[1]

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Rhodanine derivatives have shown interesting biological activities. In the series of (*Z*)-5-arylmethylidenerhodanines, inhibition of *Staphylococcus* spp. was detected in the past.[1] Recently, selected compounds were re-tested on collection strains and evaluated in advanced studies, e.g. bacteriocid/bacteriostatic effect and checkerboard with some standard antibiotics.

Despite the rhodanine scaffold (2-thioxothiazolidin-4-one) being included in the PAINS filter (pan assay interference compounds)[2], it can serve in drug design for scaffold hopping approach[3,4]. Oxygen isosteres of some (*Z*)-5-arylmethylidenerhodanines were prepared, tested on antimicrobial activity, including antimycobacterial and compared with rhodanines.

The study was supported by Progres Q42 and SVV 260 401 (both from Charles University, Czech Republic).

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BPC9

THE WAY FROM THE SYNTHESIS TO POTENTIAL CLINICAL TRIALS - FOCUSED ON CANDIDATE ANTIBACTERIAL DRUGS, CHALCONES

KONEČNÁ, K.,[1] KUČEROVÁ-CHLUPÁČOVÁ, M.,[2] DIEPOLTOVÁ, A.,[1] TREJTNAR, F.,[3] JANĎOUREK, O.,[1] VOXOVÁ, B.,[1] DOLEŽAL, M.,[2]

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Chalcones and their derivates represent a group of compounds with a wide range of biological activities.[1] According to this fact, these compounds can be rightfully included in the group of a privileged structures in medicinal chemistry and they represent promising starting points for new drug design.

In our study, we have focused on the investigation of the antimicrobial activity of newly designed and synthesized chalcone derivates. The total number of twelve compounds has been subjected to evaluation of antimicrobial potential. Based on results from the basic methodical approach for the antimicrobial activity testing, two of these compounds were selected for advanced preclinical study.

In an advanced study, the antibacterial activity was confirmed by using bacterial strains, clinical isolates that fully represent the epidemiological situation in medical practice. Further, the investigation of *in vitro* (HepG2 cell line) and *in vivo* toxicity (acute and subacute toxicity testing, the invertebrate model *Galleria mellonella*)[2] was done. In view of previous satisfactory results, the *in vitro* interactions (checkerboard studies)[3] of candidate tested compounds with selected antibiotics commonly used in medical practice were further investigated in order to identify a "partner drug" for synergic interaction.

The study was supported by Progres Q42 and SVV 260 401 (both from Charles University, Czech Republic).

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BPC10

DESIGN AND SYNTHESIS OF CASEIN KINASE II (CK2)/ HISTONE DEACETYLASES (HDAC) DUAL INHIBITIORS

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The aim of this study is to design and synthesize dual inhibitors combining the pharmacophores of the protein kinase CK2 and Histone Deacetylase (HDAC), see Figure below. CK2 is a ubiquitous serine/threonine protein kinase, whose upregulation is linked to tumor progression.[1] On the other hand, HDACs are a class of epigenetic enzymes responsible for gene silencing. Altered expression and mutations of genes that encode HDACs is linked to tumor development.[2] Synthetic procedures to obtain final compounds will be discussed in details during the presentation.

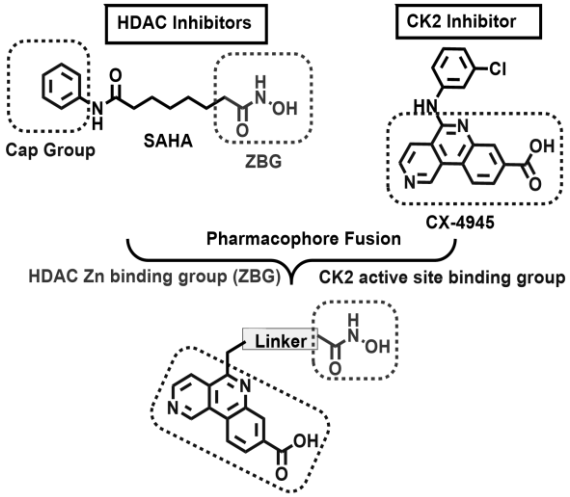

Figure: Design rational of title compounds.

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DESIGN, SYNTHESIS AND BIOLOGICAL EVALUATION OF POSITIONAL DERIVATIVES OF A SERIES OF N-(PYRAZIN-2-YL)CARBOXAMIDES

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Tuberculosis, a disease caused by Mycobacterium Tuberculosis, is leading cause of death worldwide[1] among infectious diseases and major threat to public health. Tuberculosis can effectively be treated with first-line anti-TB drugs however, due to rising antimicrobial resistance new approach to eradicate the disease is needed. A series of new N-(pyrazin-2-yl)carboxamides as potential antimycobacterial and antibacterial agent is presented. Derivatives to be presented are compounds based on positional derivatives of picolinic acid linked to pyrazine derivatives (pyrazin-2-amine, 6-chloropyrazin-2-amine, propyl 5-aminopyrazine-2-carboxylate), 4-amino-2-hydroxybenzoic acid or 4-aminobenzoic acid by amidic bond. Compounds were tested for biological activity against selected strains of *Mycobacterium* (*M. tuberculosis* H37Rv, *M. tuberculosis* H37Ra, *M. kansasii*, *M. avium*, *M. smegmatis*, *M. aurum)*. The minimum inhibitory concentration (MIC) for tested mycobacterial strains was determined for all tested compounds beside isoniazid, ciprofloxacin and rifampicin as a reference standard drug. Results of the biological testing and structure activity relationships are discussed in the presentation.

The study was supported by the Ministry of Education, Youth and Sports of the Czech Republic (SVV 260 401) and by Grant Agency of Charles University (project C-C3/1572317).

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BPC12

SYNTHESIS OF FREE OMEGA-HYDROXY CERAMIDES AND THEIR BEHAVIOUR IN THE STRATUM CORNEUM MODEL LIPID MEMBRANES

SOMMEROVÁ, V.,[1] OPÁLKA, L.,[1] SVATOŠOVÁ, L.,[1] VÁVROVÁ, K.,[1]

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Omega hydroxy ceramides (O-Cer) belong to a subclass of Cer with ultralong ω-hydroxylated *N*-acyl chains. In extracellular spaces of human *stratum corneum* (SC), they are present in the free form or linked to the surface of corneocytes via their free hydroxy group and form the corneocyte lipid envelope (CLE). The main aim of this project was to prepare 3 subclasses of O-Cer (Cer OS, OP and OdS) using an improved synthetic strategy and study their behaviour after their addition into model lipid membranes.

Complete synthesis of O-Cer has not yet been reported. We modified previously published procedure, where we focused on possible improvements of the synthesis of 32- hydroxydotriacontanoic acid, the backbone of O-Cer. The previously used Wittig reaction was changed for other olefinations, *e.g*. Julia and Julia-Kocienski reactions, which led to a significant improvement in the reaction yield.

Synthesized O-Cer were added into model lipid membranes consisting of a mixture of Cer, free fatty acids, cholesterol and cholesteryl sulfate mimicking the composition of SC. Membrane organization showed that an addition of O-Cer does not change the arrangement in the long periodicity phase (~12.3 nm), essential for the proper barrier function. Complete replacement of acylCer with O-Cer led to a formation of a new phase with shorter repeat distance (~10.7 nm). Permeability of the model membranes did not change significantly after an addition of O-Cer, however the complete replacement of acylCer with O-Cer increased permeability. In conclusion, the addition of O-Cer to the membrane did not improve the barrier properties and after a complete replacement of acylCer with O-Cer, the barrier was even more perturbed.

The study was supported by the Czech Science Foundation (19-09135J) and by Charles University (GAUK 1194119).

SYNTHESIS OF NOVEL 2,3-DISUBSTITUTED PYRAZINES AS POTENTIAL ANTIMICROBIALS

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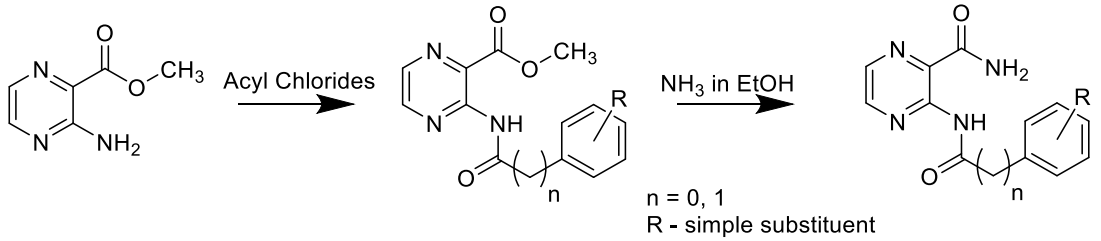
This research project is focused on synthesis of novel 3-substituted derivatives of pyrazinamide. The synthesis involves acylation of amino group of 3-aminopyrazine-2-carboxylate with acyl chlorides (benzoyl chlorides or phenylacetyl chlorides), followed by ammonolysis by ammonia in dry ethanol (Scheme 1).



Scheme 1. Synthesis of final compounds

The compounds will be assessed for *in vitro* antimicrobial activity against several mycobacterial strains (*Mycobacterium tuberculosis* H37Ra and H37Rv, *M. avium, M. kansasii, M. smegmatis, M. aurum*) and bacterial and fungal strains of clinical importance.

As an off-spin to this project, the compounds will also be studied as potential inhibitors of (human) prolyl-tRNA synthetase. This is rationalized by their structural similarity to confirmed inhibitors reported in literature[1].

The study was supported by the Ministry of Education, Youth and Sports of the Czech Republic (SVV 260 401) and by CELSA—Project title: Structure-based design of new antitubercular medicines—KU Leuven (Arthur Van Aerschot)—Charles University in Prague (Martin Doležal).

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BPC14

N-PYRAZINOYL SUBSTITUTED AMINO ACIDS AS POTENTIAL ANTIMYCOBACTERIAL AGENTS – SYNTHESIS AND BIOLOGICAL EVALUATION OF ENANTIOMERS

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Tuberculosis is an infectious disease caused by *Mycobacterium tuberculosis* (Mtb), each year causing millions of deaths. We present synthesis and biological evaluation of new potential antimycobacterial compounds containing fragment of the first-line antitubercular drug pyrazinamide (PZA), coupled with methyl or ethyl esters of selected amino acids (Fig. 1). The antimicrobial activity was evaluated on a variety of mycobacterial strains including *Mycobacterium tuberculosis* (Mtb) H37Ra and bacterial and fungal strains of clinical importance *e.g. Staphylococcus aureus* or *Aspergillus flavus*. Emphasis was made on comparison of activities of individual enantiomers.

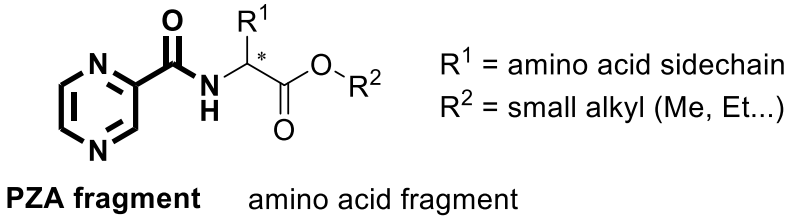

Fig. 1 General structure of the synthesized compounds

Overall, high activity against Mtb was seen in derivatives containing more lipophilic L-amino acids. The most active derivative contained phenylglycine moiety (MIC <1.98 μg/ml, <7.3 μM). Compounds possessed low cytotoxicity in HepG2 cell line (IC_{50} >500 μM) and good selectivity towards Mtb (SI >40). No significant activity was detected against tested bacterial and fungal strains. To our best knowledge, this is the first study comparing the activities of D- and L-amino acid derivatives of pyrazinamide as potential antimycobacterial compounds.

The study was supported by the Ministry of Education, Youth and Sports of the Czech Republic (SVV 260 401).

BPC15

SYNTHESIS OF SILICON COMPLEXES OF TETRAPYRAZINOPORPHYRAZINES

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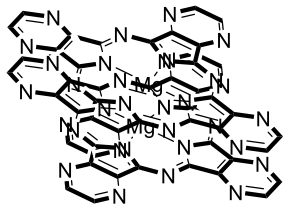
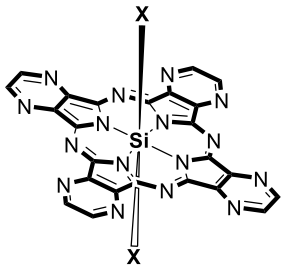
Azaphthalocyanines such as tetrapyrazinoporphyrazines are widely examined compounds. Due to their large system of conjugated double bonds, they posses interesting photophysical and photochemical properties. They find use in many medicinal fields as photodynamic therapy, monitoring RT-PCR or diagnostic imaging. As their structure is planar, strong π-π interactions between macrocycles cause aggregation of molecules.[1] This is an undesirable property of all azaphthalocyanine derivatives, because they loose their photoactivity in this state. One approach to suppress aggregation presents an introduction of suitable metal cation into the macrocyclic core. Silicon cation has been used mainly in phthalocyanine chemistry for this intention yet.[2] Its binding capacity exceeds coordinating bonds in the macrocycle core and provides spear axiall bonds, which can bear bulky substituents creating sufficient inhibition of the aggregation proccess. In this project we focus on different ways of silicon tetrapyrazinoporphyrazine synthesis.





The study was supported by Charles University (reg. No. SVV 260401).

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(*E*)-2-(2-ISONICOTINOYLHYDRAZINEYLIDENE)PROPANOIC ACID DERIVATIVES AS PROMISING ANTIMYCOBACTERIAL SUBSTANCES

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(*E*)-2-(2-Isonicotinoyl)hydrazonopropanoic acid has been presented and tested as an antimycobacterial agent by Kryukova et al.[1] in the Soviet Union in the 1970s. A basic set of antibacterial tests has been described. Since then, derivatives of this compound have been presented only randomly. We are introducing a new comprehensive series in which we have been working on adjusting this structural motif (Fig. 1).

We are focused primarily on modifications of free carboxyl group by various amines or phenols to yield functional derivatives (amides and esters) *via* EDC coupling catalysed by 1-hydroxybenzotriazole or 4-(dimethylamino)pyridine.

The prepared compounds were tested against *Mycobacterium tuberculosis* and some atypical strains of mycobacteria (*M. avium, M. kansasii*) with significantly lower MIC values (sometimes up to 64 times lower) compared to the parent drug isoniazid (INH) used as a synthetic precursor. The derivatives don't show cytotoxicity to mammalian cells (assays were performed on HepG2 and MonoMac6 cells) and exhibit a much greater ability to inhibit growth of the mycobacterial cells in comparison to the INH.

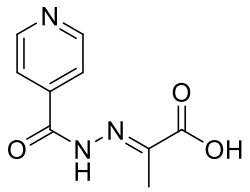

Figure 3 *– (E)-2-(2-Isonicotinoylhydrazineylidene)propanoic acid*

The study was supported by the Czech Science Foundation (reg. No. 17-27514Y) and Charles University (SVV 260 401).

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N-METHYLHYDRAZINE-1-CARBOXAMIDES AS POTENTIAL CHOLINESTERASES INHIBITORS

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Due to the increasing number of cases, Alzheimer's disease is a neurodegenerative disease that represents a serious threat to mankind. The impairment that this disease causes to one's health, urge for the research of new potential drugs for the treatment of this illness. Nowadays, the therapy of Alzheimer's disease is focused primarily on the use of acetylcholinesterase (AChE) inhibitors and dual AChE-butyrylcholinesterase (BuChE) inhibitors.[1] Based on this fact, derivatives of *N*-methyl-hydrazine-1-carboxamide (Fig. 1) have been designed within this goal. The ability of the different derivatives to inhibit both AChE and BuChE was evaluated using modified Ellman's method.[2] AChE was inhibited with IC_{50} values within the range of 44-73 μM, whereas BuChE was inhibited with IC_{50} within the range of 170-514 μM. The most active compound for AChE inhibition was 2-(4-chlorobenzoyl)-*N*-methylhydrazine-1-carboxamide (IC_{50} = 44.08 μM) (Fig. 2). More derivatives will be tested in order to determine the structure-activity relationship.

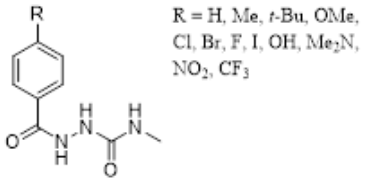

Fig. 1 *N*-Methylhydrazine-1-carboxamides

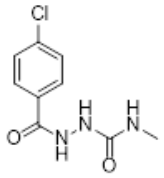

Fig. 2 The most active AChE inhibitor

The study was supported by the Czech Science Foundation projects No. 17-27514Y and 20-*19638Y*.

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Wednesday 22. January 2020

Lecture hall B

Session 2 - Clinical and Social Pharmacy: ***12:30 – 15:30***
Chairpersons: Prof. Rob Horne and Prof. Jiří Vlček

CSP1

ANALYSIS AND MANAGEMENT OF NURSES' MEDICATION ERRORS DURING DRUG ADMINISTRATION

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Improving safety is currently one of the priorities in the field of healthcare provision. Medication errors during drug administration (DAMEs) are quite frequent abroad[1]. In the Czech Republic, data resulting from the reporting of adverse drug events are rather underestimated or missing. The aim of this study is to analyze the occurrence of nurses' DAMEs, propose appropriate interventions to minimize DAMEs and assess their effectiveness.

In a prospective interventional study, trained pharmacists observed nurses' DAMEs on seven wards of an inpatient rehabilitation healthcare facility. During April 2018, baseline prevalence and types of DAMEs were determined. Patient risk assessment was performed in order to identify serious DAMEs. An intervention phase was conducted in February and March 2019, including repeated discussions with healthcare professionals and facility management, adjustment of internal guidelines, printed educational materials, and seminars. In May 2019, a postinterventional observation of nurses' DAMEs took place to evaluate the effectiveness of interventions. Data were processed in Wolfram Mathematica using descriptive statistics and chi-square test.

During the baseline and postinterventional observations, 4661 and 4386 individual drug administrations were monitored, respectively. The total number of DAMEs was significantly reduced from 918 (19.70%) to 148 (3.37%) ($p < 0.001$). The prevalence of serious DAMEs (e.g., administration of the wrong drug) decreased from 0.45% to 0.20% of all individual drug administrations.

As a result of interventions, DAMEs were decreased. The sustainability of the interventions will be monitored within one year.

The study was supported by Charles University grant (SVV 260 417).

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DRUG-RELATED HOSPITAL ADMISSIONS FOLLOWING EMERGENCY DEPARTMENT VISIT: A CROSS-SECTIONAL STUDY

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Drug-related hospital admissions (DRA) have attracted much research attention worldwide. The aims of this study are to determine the prevalence and preventability of DRA, to identify the implicated medications in DRA and to examine the preventability aspects of DRA. The methodology of this cross-sectional observational study draws upon the drug-related admissions adjudication guide developed by Thevelin et al.[1] In the first step relevant clinical data are abstracted into an Access database. The second step includes screening for potential adverse drug events which are the main or contributory reason for hospital admissions. The third step is drug-related admission adjudication process, which consists of causality assessment and assessment of contribution to hospital admission. Hospital admissions to University Hospital Hradec Králové in 2018 following emergency department visit are included in this study. So far, 879 hospital admissions have been included, and 147 DRA have been identified (112 related to treatment safety, 35 related to treatment effectiveness). The prevalence of DRA was 16.7% (95% CI 14.3-19.2). Antithrombotic agents, psycholeptics, analgesics, antiinflammatory and antirheumatic products and corticosteroids for systemic use represented the most common medication classes involved in DRA related to treatment safety. Diuretics, antihypertensives, drugs used in diabetes, antithrombotic agents and antibacterials for systemic use represented the most common medication classes involved in DRA related to treatment effectiveness.

The study was supported by Charles University (Project SVV 260 417, PROGRES Q42)

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CSP3

MATERNAL NUTRITIONAL INTAKE IN RELATIONSHIP WITH PREGNANCY OUTCOMES IN CZECH PREGNANT WOMEN

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Optimal maternal nutrition contributes to the maintenance homeostasis of pregnant organism and promotes proper fetal development. The aim of the study was to evaluate the nutritional intake of energy and macronutrients (PNEM) in relation to resting energy expenditure (REE) and birth parameters in Czech pregnant women throughout the pregnancy, what is not well known. Sixty-five healthy Czech pregnant women, with average 29 years old, 166.5 cm and 67.8 kg attended to our study. REE measurements were recorded after 12 h fasting, by indirect calorimetry in three periods: G1 (17-27 gestational week), G2 (28-35 gw.) and G3 (36-38 gw.). PNEM was obtained in weekly records and nutritional analysis was evaluated by the computer program NutriDan. PNEM, expressed per kilogram of woman's weight, was significantly related to REE. Energy intake decreased with increasing of pregnancy state (2061 kcal per day, 1965 kcal per day, 1962 kcal per day). Decreasing trends were reported in the areas of protein intake (79.91 g, 75.63 g, 73.94 g), fat (76.66 g, 75.06 g, 72.4 g) and carbohydrates (239.6 g, 223.3 g, 225.2 g). In all trimesters, PNEM significantly correlated with the birth weight of the newborn ($p < 0.001$). In the 2nd trimester, PNEM positively associated with the birth length ($p < 0.01$) and negative (except for carbohydrates) with the duration of labor ($p < 0.01$). Increased PNEM in the last trimester was significantly associated with a shortening of the pregnancy period ($p < 0.01$).

Intake of nutritional energy and macronutrients significantly affects energy expenditure and correlates with birth parameters in all trimesters of pregnancy.

The study was supported by GA UK č. 1306218, SVV/2019/260417, MH CZ –DRO (UHHK, 00179906) and PROGRES Q42

CSP4

DEVELOPMENT, IMPLEMENTATION AND TESTING OF MEDICATION ADHERENCE ENHANCING INTERVENTION IN KIDNEY TRANSPLANT OUTPATIENTS: EFFECTIVENESS–IMPLEMENTATION STUDY (TAKTIS)

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Patients after kidney transplantation (KTx) are on long-term immunosuppression with an emphasis on strict medication adherence. Nonadherence to immunosuppression, which in KTx setting means mainly during implementation phase (e.g. dosing, timing), leads to poor clinical and economical outcomes. This substudy is part of a multiphase project TAKTIS (developing, implementing, and testing an integrated care model for adults after KTx). The ongoing project is single-centre, prospective and interventional. As a part of contextual analysis, this substudy aimed to evaluate the prevalence of nonadherence and attitudes toward immunosuppression. All adults at least 4 weeks after KTx were included, who were on basal immunosuppression and signed a written consent with study participation. Data was collected using questionnaires (e.g. Basel Assessment of Adherence to Immunosuppressive Medications Scale (BAASIS-CZ©); specific subscale of Beliefs about Medicine Questionnaire (BMQ-CZ©)) and a review of medical charts (e.g. imunosuppressives blood levels). Of 415 patients in regular follow up, 390 met inclusion criteria and 359 (92% of 390) patients fulfilled the questionnaires. Main measured immunosuppressives were tacrolimus, cyclosporine, sirolimus, and everolimus in 238, 79, 46, and 4 cases, respectively. According to BAASIS-CZ©, 133 (37% of 359) patients were nonadherent with deviations in taking (45; 12.5%), timing (118; 32.9%), and dosing (3; 0.8%). One patient completely discontinued to take all immunosuppression. Mean necessity score was 4.3 ± 0.57 of 5.0 points (= maximal necessity) and mean concern score was 2.6 ± 0.71 of 5.0 (= maximal concerns). To conclude, prevalence of medication nonadherence in implementation phase was high among patients after KTx with the most frequent deviation in timing of immunosuppression. This information is essential in contextual analysis needed for TAKTIS care model development.

The study was supported by Charles University (Project SVV 260 417).

CSP5

ANALYSIS OF DRUG-RELATED PROBLEMS IN PATIENTS AFTER KIDNEY TRANSPLANTATION

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Patients after kidney transplantation (KTx) in care of nephrologist and other specialists are specific by polypharmacy, long-term immunosuppression and changed renal functions, so they may be in increased risk of drug-related problems (DRPs). The aim of this study was to analyze the prevalence of DRPs and to determine the riskiest areas of their pharmacotherapy. This cross-sectional study was conducted at the University Hospital Hradec Kralove in the Czech Republic. All outpatients aged ≥18 years, at least 3 weeks after KTx treated by maintenance immunosuppression were included. Data were collected during one-year period (2016–2017) from electronic medical records. Personal, family, occupational, allergic and drug related anamnestic data, selected physical as well as laboratory parameters were collected in a pre-created electronic database. The identified DRPs were classified according to the modified Pharmaceutical Care Network Europe classification V5.01 and their relevance was assessed by 2 pharmacists. The data was evaluated by descriptive statistics. Of the total of 412 outpatients at the clinic, 211 were enrolled (123 men; aged 55.8 ± 12.41). Patients were 6.6 ± 5.9 years after KTx and used in average 11.3 drugs/patient/day. The total of 668 DRPs were identified, which was equivalent to 3.17 DRPs/patient. Most frequent DRPs were missing of clearly indicated drugs in 27.4% (e.g. calcium or vitamin D), inappropriate dose timing in 16.0% and no clear indication for the drug in 12.6% of DRPs (e.g. aspirin or gastroprotection). The most relevant DRPs (5.2%) were e.g. contraindicated (CI) combination of cyclosporin and simvastatin, duplicity of betaxolol, CI nitrofurantoin in relation to decreased renal function, etc. DRPs were common in KTx outpatients, the most prone was the long-term pharmacotherapy. Medication review conducted by pharmacists can effectively minimize DRPs and thus enhance safety of pharmacotherapy.

The study was supported by Charles University grant (SVV 260 417).

CSP6

POTENTIALLY INAPPROPRIATE PRESCRIBING IN OLDER ADULTS IN CENTRAL AND EASTERN EUROPE AND ASSOCIATED RISK FACTORS - PRELIMINARY RESULTS OF TWO SYSTEMATIC LITERATURE REVIEWS

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Potentially inappropriate prescribing (PIP) in older adults is highly prevalent in Europe and risk factors (RFs) of PIP have been described by several studies1,2,3,4. The aim of our study was to conduct two systematic literature reviews determining 1) the prevalence of PIP in Central and Eastern European Countries (CEECs) participating in the Horizon 2020 EUROAGEISM FIP7 project (Albania, Bulgaria, Croatia (HR), Czech Republic (CZ), Estonia, Lithuania, Serbia and Slovakia), and 2) to document social, economic and healthcare-provision related RFs of PIP.

We searched in SCOPUS and MEDLINE databases (papers published by 2019) and included only primary studies published in English as full-texts. Of 146 and 2740 studies in primary literature search, 14 and 69 were selected using pre-defined criteria, respectively.

The prevalence of PIP ranged from 15.7% (CZ) to 68.8% (HR). In total, 72 RFs were analyzed. Among economic and social RFs, “patients’ low income” reached the highest odds ratio (OR=2.48 (1.82-3.39), $p<0.001$) and “not having a partner” (OR=1.50 (1.10-2.10), $p<0.05$). Among care-related RFs these were ”residency in long-term care institutions” and “admission to acute care” (OR=2.29 (2.25-2.33), $p<0.001$ and OR=3.35 (2.43-4.62), $p<0.05$, respectively), as well as “care provided by non-geriatricians” (OR=5.54 (1.62-18.89), $p=0.01$) or “by more prescribers” (OR=1.40 (1.29-1.51), $p<0.001$).

Results create an important base for the started EUROAGEISM H2020 FIP7 project, assessing PIP in older adults in 10 European and other countries. This project supports the development of geriatric clinical pharmacy in different settings of care.

The study was supported by the EUROAGEISM H2020 project, FIP7 program (ITN-MSCF No764632), INOMED project reg. No.CZ.02.1.01/0.0/0.0/ 18069/0010046, SVV 260 417 and PROGRESS Q42 program at the Department of Social and Clinical Pharmacy, Charles University - Scientific group “Ageing and Changes in the Therapeutic Value of Drugs in the AgeD” chaired by Assoc. Prof. Daniela Fialová, PharmDr., Ph.D.

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CSP7

INITIAL EXPERIMENT WITH THE LEFT ATRIAL APPENDAGE OCCLUSION WITH THE AMPLATZER AMULET™

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Atrial fibrillation is the most common rhythm disorder in clinical practice. Stroke is one of the most severe thromboembolic disorders associated with atrial fibrillation.[1] The CHA_2DS_2VASc scoring system assess the risk of stroke in patients with atrial fibrillation.[2] Oral anticoagulation is recommended in atrial fibrillation patients at moderate to high risk of stroke and thromboembolism.[3] The HAS-BLED scoring system evaluates the risk of bleeding in patients receiving anticoagulation therapy.[4] Percutaneous left atrial appendage occlusion provides a treatment alternative for patients with atrial fibrillation at high risk of stroke in whom anticoagulation therapy is associated with high bleeding risk.[5]

Goals of our observational, retrospective, multi-centre, case-series study were: 1) describe the initial experience with Amplatzer Amulet™ the left atrium appendage occlusion in Slovakia; 2) evaluate the effectiveness and safety of the procedure in stroke prevention in patients with atrial fibrillation.

We analyzed 93 patients with atrial fibrillation at high risk of stroke undergoing left atrial appendage occlusion from June 2015 to October 2018. The mean patient age was 70.9 ± 8.6 years. The mean CHA_2DS_2VASc and HASBLED score was 4.4 ± 4.4 and 3.5 ± 0.9, respectively. The left atrial appendage was successfully closed in 98.9% (92) of patients. The mean total procedural time was 110.4 ± 54.5 min. Periprocedural complications were observed in 5.4% (5) of patients. Three months after the procedure, small postprocedural leaks up to 3 mm were observed in 89.2% (83) of patients.

In this initial experience study, left atrial appendage occlusion was shown to be an effective and safe alternative to anticoagulation therapy in patients with atrial fibrillation at high risk of stroke for whom anticoagulation therapy is associated with high bleeding risk.

The study was supported by Faculty of Pharmacy, Comenius University, Bratislava

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CSP8

IMPACT OF A COMPUTERIZED PROTOCOL ON THROMBOPROPHYLAXIS USE IN GENERAL SURGERY: STUDY DESIGN

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A large proportion of hospitalized patients are at risk for venous thromboembolism (VTE), but there is a low rate of appropriate prophylaxis in clinical practice[1]. According to the American College of Chest Physicians (ACCP) guidelines, all hospitalized patients admitted in a surgical ward should be assessed for the risk of VTE[2]. Various strategies to improve the use of thromboprophylaxis have been recommended including the computerized systems[3]. To our knowledge, there is no protocol standardization or any other active strategy leading to the appropriate thromboprophylaxis in surgical patients described in the Czech literature. In the past, there was also a lack of standardization in prescribing thromboprophylaxis to the surgical patients in our hospital. Therefore we decided to create and implement the VTE prophylaxis computerized protocol (VTEP-CP) as a decision support tool for physicians. After the protocol has been routinely used by physicians for several years, we decided to analyze the rate of compliance with the guidelines on VTE prophylaxis and to determine the incidence of VTE and major bleeding before and after implementation of VTEP-CP. The list of patients admitted in the surgical ward that underwent elective general surgery was provided through the hospital information system for a period of eleven months in 2012 (group A = before VTEP-CP implementation) and eleven months in 2014 (group B = before VTEP-CP implementation). We were able to obtain some of the required data of the patients in electronic form directly from the hospital information system and thus create a baseline database that we now must complete with the data from the patient medical records. Patients in group A are scored by the VTEP-CP using the data from the hospital admission form. For group B, the data from the VTEP-CP are used and also medical records are reviewed. The risk score, the dose and type of LMWH recommended by the VTEP-CP, the dose and type of LMWH administered to the patient and usage of mechanical prophylaxis is registered for both groups. We also review the documentation of patients for the diagnosis of VTE and signs or diagnosis of major bleeding.
In the presentation, we will discuss the study design, its limitation and the possible benefit of the research in the field of clinical pharmacy.

The study was supported by Project SVV 260 417, PROGRES Q42

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CSP9

NEUTROPHIL-TO-LYMPHOCYTE RATIO AND PROGNOSTIC INFLAMMATORY AND NUTRITIONAL INDEX AS THE PREDICTORS OF POSTOPERATIVE INFECTION AFTER KNEE OR HIP ARTHROPLASTY

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Surgical site infection (SSI) is a potential complication of all surgical procedures and also the second most common type of nosocomial infection. The very presence of SSI leads to an increase in mortality. In patients with developed infection who underwent a surgical procedure, there is double mortality compared to non-infected patients. SSI prevalence may be reduced by various preoperative and postoperative measures. One of the ways in which SSI is affected is antibiotic prophylaxis (AP). It is desirable to adjust AP length for arthroplasty, according to individual SSI risk estimated by appropriate processes. The aim of this study is to stratify patients based on the risk of postoperative infection and to verify the findings in clinical practice on the basis of examinations focusing mainly on laboratory tests, especially neutrophil-to-lymphocyte (NLR) ratio and prognostic inflammatory and nutritional index (PINI). NLR is an easily verifiable, easy, broadly robust and appropriate laboratory test. Neutrophil levels in the blood are increased due to cytokines, while lymphocyte counts are reduced by surgical trauma. The increase occurs within 2 days after surgery and the return to physiological values takes place in a matter of days. It depends on the nutritional status of the patient, therefore its use in combination with PINI seems appropriate. These properties have been demonstrated in the diagnosis of cardiovascular diseases. In 2020, we plan to perform a prospective interventional study with an approximate number of 300 patients. In addition to the systematic literature review, we will collect patient and surgical procedure data before, during and after surgery. The usability of NLR and PINI will be evaluated with the postoperative complication analysis. Complications will be monitored 28–35 days after the surgery. Regarding these results, the interventions will be arranged to optimize and individualize the use of AP.

The study was supported by Charles University (Project SVV 260 417).

CSP10

AVAILABILITY OF INFORMATION ON LOWER GERIATRIC DOSING OF POTENTIALLY INAPPROPRIATE MEDICATIONS (PIM_S) IN NATIONAL DRUG FORMULARIES AND SUMMARY OF PRODUCT CHARACTERISTICS (SPC_S)

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One of the main public health concerns nowadays is the appropriate prescribing for older patients [1]. The concept of potentially inappropriate medications in the aged (so called PIMs-medications having higher risks than benefits in older adults or potentially ineffective in the aged) was defined to better ensure the medication safety in older adults [2]. The aim of our study was to clarify for how many PIMs (potentially inappropriate medications) geriatric dosing is stated in official drug information sources. Information on recommended single and daily geriatric dose for all PIMs (364) identified by expert panels in different explicit criteria has been searched between March–May 2019 using AIFA website (Agenzia Italiana del Farmaco), BNF (British National Formulary) and US PDR (US Prescriber's Drug Reference). The same single dose for middle age and geriatric population was found in all SPCs for 234 (64.3%) PIMs, lower single dose for geriatric patients was clarified for 61 (16.8%) PIMs in all SPCs and for 19 (5.2%) in some SPCs. For daily geriatric dosing, 3 above stated results were 212 (58.2%), 69 (19.0%) and 33 (9.1%), respectively. For 50 (13.7%) PIMs no information was found about specific approaches in geriatrics and for 6.9% PIMs only ''general warnings to be more cautious in older adults'' were available. Recommendation of geriatric dosing was stated in less than 30% of SPCs of PIMs. In the majority of SPCs, the geriatric dose was not clarified. Therefore a new evidence on appropriate geriatric dosing from clinical and/or observational studies is needed to clarify specific aspects of the use of PIMs (indications, single and daily dosing) in order to better ensure higher safety of medications in geriatric patients.

The study was supported by INOMED project reg. No.CZ.02.1.01/0.0/0.0/ 18069/0010046, EU COST Action IS1402, EUROAGEISM H2020 project (ITN-MSCFNo764632), SVV 260 417 and PROGRESS Q42 KSKF FaF UK- Scientific group "Aging and Changes in the Therapeutic Value of Drugs in the AgeD" chaired by Assoc. Prof. Daniela Fialová, PharmDr., PhD.

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CSP11

SPECIFICITY OF THE EU(7)-PIM LIST OF POTENTIALLY INAPPROPRIATE MEDICATIONS FOR THE EVALUATION OF RATIONALITY OF DRUG PRESCRIBING IN OLDER ADULTS IN EUROPEAN COUNTRIES

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The EU(7)-PIM (potentially inappropriate medication) list presents nowadays the most comprehensive and up-to-date tool for evaluation of PIM prescribing in Europe.[1,2] The aim of our study was to determine the specificity of EU(7)-PIM list in ten European countries.

Research teams from Czech Republic, Croatia, Estonia, Hungary, Poland, Serbia, Slovak Republic, Spain, Portugal and Turkey participated in this study conducted by WG1b group of the EU COST Action IS1402 initiative. Data on approval rates of PIMs and their availability on pharmaceutical markets have been obtained from databases of national drug regulatory authorities in the period October 2015-November 2018. The EU(7)-PIM list was applied in this study as a research tool.

Approval rates for EU(7)-PIMs ranged from 39.0% in Estonia to 71.4% in Spain. Higher percentages of approved PIMs were documented in Spain (71.4%), Turkey (67.5%), Portugal (67.1%), and Poland (60.6%), lower in Hungary (55.5%), Czech Republic (51.1%), Slovak Republic (47.9%), Serbia (42.8%), Croatia (41.5%) and Estonia (39.0%). The majority of approved PIMs were also currently marketed in all countries except in Turkey (19.8–21.7% not marketed PIMs) and less than 20% of PIMs were available as over-the-counter medications (except in Turkey, 46.4–48.1%).

Applicability of the EU(7)-PIM list is limited in some countries. The EU project EUROAGEISM H2020 (2017–2021) that focuses on PIM prescribing and regulatory measures in Central and Eastern European countries must consider these limits.

The study was supported by the EU COST Action IS1402, EUROAGEISM H2020 project (ITN-MSCF No764632), INOMED project reg. No.CZ.02.1.01/0.0/0.0/ 18069/0010046, SVV 260 417 and PROGRESS Q42 at the Department of Social and Clinical Pharmacy by Scientific group "Ageing and Changes in the Therapeutic Value of Drugs in the AgeD" (chaired by Assoc. Prof. Daniela Fialová, PharmDr., Ph.D).

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Wednesday 22. January 2020

Lecture hall C

Session 3 - Pharmaceutical Technology: ***12:30 – 15:30***

Chairpersons: Prof. Daniel Scherman, Assoc. Prof. Zdeňka Šklubalová, Dr. Jitka Mužíková

FT1

IMPROVING THE DISSOLUTION RATE OF POORLY SOLUBLE MELOXICAM BY CO-MILLING

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The aim of this work was to study the possibility of increasing the dissolution rate of the model drug meloxicam (MLX, BCS class II, solubility in water is 4.4 mg / ml at 25 °C[1]) using solventless co-milling with a hydrophilic drug carrier chitosan (CHIT) of 85 % deacetylation degree. Firstly, the properties of both substances were estimated. MLX particles are very fine with a mean particle size x_{50} = 3.7 μm and a relatively narrow distribution (span = 1.94). On the other hand, CHIT has platelet particles with a mean size x_{50} = 59.3 μm and a wider distribution (span = 2.30). The melting point T_m = 262.4 °C was detected for MLX (crystalline substance). CHIT shows glass transition temperature T_g at 122.5 °C (amorphous substance). Subsequently, the binary powder mixtures were prepared at 1:1 and 1:8 ratios in a planetary ball mill. The effects of ball size, rpm and milling time on properties of co-milled mixtures were investigated. The changes in the particle size and particle size distribution were monitored by laser diffraction using a dry cell. Flow-through cell type of dissolution (USP 4, phosphate buffer pH 6.8) with open loop was used to evaluate the dissolution rate of the drug in the co-milled powder mixtures. The detected dissolution rate r (mg × dm^{-3} × s^{-1}) of MLX in the MLX:CHIT mixture co-milled in 1:8 ratio for 15 minutes was approximately four times higher than the dissolution rate of MLX within the first ten minutes. The reason is presumably an increase in specific surface area of the micronized drug particles together with deagglomeration during the co-milling/mixing with the hydrophilic carrier with larger particles.

The study was supported by the Funding Agency of Charles University under Grant No. 1286218/201, by SVV 260 401 and Zentiva, k. s.

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AVALANCHE TESTING AND ITS RELATIONSHIP TO COHESION OF POWDERS

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Powders and granular materials are two-phase systems where individual solid particles touch each other and are diffused in gaseous surroundings; the interparticle contacts influence the behaviour of the powder bed. Powder properties depend on many parameters such as particle size, shape, density, cohesive forces as well as on the air humidity and temperature.[1] More cohesive materials can cause flow difficulties during pharmaceutical processes. Therefore, shear testing and new methods of avalanche measurements studying dynamic powder behaviour are used to describe these materials.

It was observed previously that some portion of powder microcrystalline cellulose (MCC) in mixtures with pellets made of microcrystalline cellulose (C100) improved compressibility of mixtures into tablets. In this work, the influence of MCC on the interparticle cohesion and flow properties were studied using the automated shear cell (ShearScan) and dynamic flow measurements (Revolution powder analyser). The more MCC in the mixture the higher cohesion was observed following with worsening in avalanche behaviour from slumping (C100 and M90) through cascading (M80-M60) to cataracting when 50 % or more of MCC was added. The relationship between the cohesion and avalanche angle was described with the linear regression with the coefficient of regression R = 0.9242. The results show the importance of careful choice of mixture composition to achieve the optimum composition for both good compression and flowability.

The study was supported by the Funding Agency of Charles University under Grant No. 1286218/2018 and by SVV 260 401.

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FT3

CHARACTERIZATION OF RHEOLOGICAL PROPERTIES OF POLYMERS FOR FORMULATION OF LIQUISOLID SYSTEMS TARGETED TO THE COLON

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Targeting drugs directly to the colon is beneficial for the local treatment of inflammatory bowel diseases and other colonic pathologies. Drug delivery systems which can control or sustain drug release in the colon is needed in order to achieve satisfactory drug levels for a longer duration, thereby minimizing dosing frequency and adverse effects. A possible approach to control drug release is by the formulation of liquisolid systems by incorporating hydrophilic polymers as matrices. Such polymers become hydrated in aqueous medium to form a gel layer which controls the drug release. The ability of the polymer to control drug release is partly influenced by viscosity of the hydrated gel layer. Therefore, this study aims to characterize a range of polymer candidates (guar gum, sodium alginate, sodium carboxymethyl cellulose and various grades of hydroxypropyl methylcellulose) by rheological measurements. Biorelevant media; Fasted State Simulated Gastric Fluid (FaSSGF) and Fasted State Intestinal Fluid (FaSSIF) of pH 1.6 and 6.5, respectively, were used to prepare polymer dispersions simulating the gel layer formed at the surface of hydrated matrices in the gastrointestinal tract. Flow rheology measurements were carried out on a rheometer. Flow curves were obtained, using a shear rate ramp at shear rate 0.01–100 s^{-1}. Ostwald-de Waele (power law) model was applied to describe the rheological flow behaviour. The apparent viscosities of the polymers at shear rates of practical importance were reported. Although other formulation parameters will influence the drug release, viscosity data from the rheological studies will serve as a useful basis for further studies with regards to the formulation of liquisolid systems for colon-targeted drug delivery.

The study was supported by Project No. 70119/2019 of Grant Agency of Charles University and by SVV 260 401

FT4

IN VITRO MODELS OF SKIN LIPID BARRIER

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First-line protection of the human body is carried out by the outermost skin layer, the stratum corneum (SC), which is composed of corneocytes embedded in a lipid matrix of ceramides, cholesterol and fatty acids.[1] Skin diseases are associated with modified skin barrier functions which result from alterations in the skin barrier composition. In this regard, the use of model lipid membranes is a very useful tool to mimic healthy or diseased skin states.[2]

The aim of this study is to create model lipid membranes and investigate the polymorphic nature of the lipids at different annealing conditions. Initially, skin isolated lipids were annealed at different temperatures (from room temperature to 90° C) in the presence or absence of water. Preliminary results did not show major differences for the lengths of long periodicity phase or cholesterol phase between the different annealing conditions, while short periodicity phase starts to be visible when annealing temperature is 70° C in presence of water. Moreover, even if annealing of lipids was considered an essential step for the creation of model lipid membranes, our results indicate that lipids are also able to spontaneously arrange.

The study was supported by SVV: 260401 and Czech Science Foundation (GACR 19-09135J)

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FT5

DELIVERY OF SKIN BARRIER LIPIDS TO RECONSTRUCTED HUMAN EPIDERMIS

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Skin barrier is found in the outermost part of the skin, called *stratum corneum* (SC), which consists of flattened dead cells (corneocytes) embedded in a lipid matrix. A lipid species specific for epidermis, ω-O-acylceramides (ω-O-acylcer), are essential for the organization of the two SC lipid structures: the highly organized intercellular lipid lamellae and the monolayer of lipids covalently bound to the surface of corneocytes. Both are essential for our survival on dry land.[1] One of the key enzyme in the synthesis of ω-O-acylcer is PNPLA1, which was found deficient in a subset of patients suffering from Autosomal Recessive Congenital Ichthyoses.[2] The available treatment is only symptomatic, thus, we attempted to restore skin barrier by delivering ω-O-acylcer to the SC. In this study, delivery systems for ω-O-acylcer were tested for their ability to deliver ω-O-acylcer to reconstructed human epidermis (RHE) deficient in PNPLA1. Effect of treatment on permeability (Lucifer yellow assay), ultrastructure of the SC (electron microscopy) and lipid content (LC/MS) was evaluated. Furthermore, two different models of RHE were compared for their ability to mimic diseased epidermis and protocol for application of delivery systems on RHE was developed.

The study was supported by the Czech Science Foundation (GAČR 19-09135J) and the Charles University (SVV 260401).

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FT6

SNEDDS FOR TARGETED OLIGONUCLEOTIDE DELIVERY TO INFLAMED INTESTINAL TISSUE

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Self-nanoemulsifying drug delivery systems (SNEDDS) have potential to locally deliver an anti-inflammatory acting oligonucleotide (OND) to inflamed intestinal tissue. A non-specific OND was complexed with a cationic lipid to increase its lipophilicity[1]. This allowed to load the complex (OND-CL) into SNEDDS containing medium-chain fatty acids that enhance tight junction (TJ) opening[2]. Caco-2 cells were pre-treated with Compound 48/80 (C48/80), an inhibitor of TJ opening, and subsequently incubated with OND-CL loaded in SNEDDS, blank SNEDDS (bSN) and the cationic lipid dissolved in SNEDDS both dispersed in a solution of OND, and a solution of OND. Size of dispersed nanodroplets between 180 and 215 nm together with zeta potential ~ - 8 mV are properties enabling passive targeting to the inflamed area. All treatments containing SNEDDS showed permeation of OND unlike in the case of the OND solution. The highest amount of OND permeated after treatment with OND-CL in SNEDDS. C48/80 lowered and delayed the transport of OND-CL, however, there was no significant difference in the case of bSN in presence and absence of the inhibitor. When treated with SNEDDS, TEER dropped to ~ 50% of initial values. The inhibitor C48/80 modulates opening of TJs and suggests their role in transport of OND through Caco-2 monolayer.

The study was supported by Czech Ministry of Education and Sports, project no. SVV 260 401 and Czech Grant Agency, project. No.GA17-06841S.

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POLYMERIC PARTICLES: A TOOL FOR TARGETED INFLAMMATION MANAGEMENT

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The aim of this work is to prepare biodegradable polymeric nanoparticles with encapsulated anti-inflammatory substance. Polymeric particles are actively scavenged from systemic circulation by phagocytic cells of the reticuloendothelial system. Macrophages such as Kupffer cells play an important modulatory role in the development of inflammation. Therefore, such particles could be suitable for liver targeting.[1] The encapsulation of the active substance into nanoparticles has undeniable advantages, such as reduced side effects, site specific action or reduced active substance dose.[2] A number of different variants of poly (lactic-co-glycolic) acid (PLGA) (several linear variants and a branched with polyacrylic acid) were tested for preparation of nanoparticles. These co-polymers are sufficiently stable, biodegradable and do not induce stimulation of the immune system.[3] PLGA nanoparticles of desired size (80 – 300 nm) with low polydispersity were prepared and assayed *in vitro*. Particles with size under 100 nm were prepared by emulsification solvent evaporation method. Nanoprecipitation yielded nanoparticles ranging between 150 and 200 nm. Formulations of such parameters are attractive to target cells, non-toxic and also with high cell entry demonstrated *in vitro* (more than 50 %).

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FT8

IMIQUIMOD CONTAINING LIPOSOMES FOR DERMAL DELIVERY

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Over the past years, (trans)dermal delivery has gained extensive popularity due to its advantages over other routes of administration.[1] Dermal delivery has been improved by different methods and vehicles, of which, liposomes seem to be the most studied.[2] Imiquimod (IMQ) is a topically-applied imidazoquinolon, used for the treatment of several skin diseases, like actinic keratosis and basal cell carcinoma.[3] Traditional formulations restrict IMQ's efficiency for dermal delivery because of the drug's poor solubility and low cutaneous permeability [3] The aim of the present study is, to prepare IMQ loaded liposomes and evaluate their ability to deliver the active substance to the desired skin layers. Different liposomal formulations with IMQ were prepared by using the thin film method. The physicochemical properties of the prepared formulations were determined in terms of particle size, polydispersity index, zeta potential, and entrapment efficiency. Ex vivo experiments on human tissue showed that liposomes have a potential as carriers of IMQ for dermal application

The study was supported by SVV: 260401 and Czech Science Foundation (GACR 19-09600S).

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FT9

OPTIMIZATION OF RIFAMPICIN-LOADED NANOPARTICLES PREPARATION

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In past two decades poly lactic-co-glycolic acid (PLGA) has been among the most attractive polymeric candidates used to fabricate devices for drug delivery and tissue engineering applications.[1] Using different branching agents, direct melt polycondensation without addition of catalyst led to group of PLGA with diverse architecture.[2] These polymers were used for the preparation of rifampicin-loaded nanoparticles by the nanoprecipitation method. The aim of this work was to optimize this method by selecting a suitable polymeric carrier and its concentration, the ratio of organic phase to aqueous phase, the total amount of rifampicin added, and the concentration of the previously verified stabilizer didodecyldimethylammonium bromide (DDAB). Prepared formulations were evaluated and compared by testing of their parameters such as stability, particles size, polydispersity, zeta potential, and encapsulation efficiency. Two suitable PLGA derivatives were found, star-shaped PLGA branched on tripentaerythritol appeared to be the most appropriate. The effect of the amount of stabilizer on the encapsulation efficiency was significant. Encapsulation efficiency increased with decreasing amount of stabilizer to maximum at 0.02 %, but further decrease in concentration led to the encapsulation efficiency drop, even in the case of stable formulations with low polydispersity. Dissolution tests were performed in phosphate buffer pH 7.4, and showed sustained release of rifampicin.

The study was supported by SVV 260401.

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A STUDY OF COMPRESSIBILITY AND COMPACTABILITY OF TABLETING MATERIALS WITH CHITOSAN

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Natural polysaccharides find use as excipients for the formulation of oral controlled drug release systems. Some of these systems can target drug release to the distal part of the gastrointestinal tract. One of these polysaccharides is cationic chitosan, which is safe, non-toxic and biodegradable. Its very important property is the ability to adhere to mucous, In the presence of an anionic polysaccharide (sodium alginate) it forms a polyelectrolyte complex.

The aim of this work was to study the compressibility, compactibility and lubricant sensitivity of directly compressible tableting materials containing chitosan, sodium alginate and two viscous types of hypromellose. Tableting materials with silicified microcrystalline cellulose Prosolv SMCC 90 in proportion to 1: 3 chitosan were tested as well. Compressiblity was evaluated by energy profile of compression, compatibility by tensile strength of the tablets, lubricant sensitivity by values of lubricant sensitivity ratio.

The highest total energy of compression values schowed the mixture chitosan and Prosolv SMCC 90 in the ratio 3:1. Prosolv SMCC 90 increased the values of total energy of compression at all formulations excluding the mixtures with HPMC 100M. The adding of retarding components decreased them, the most in the case of alginate sodium. Tensile strength of tablets was incresed by Prosolv SMCC 90 at all formulations. Alginate sodium and magnesium stearate decresed strength values. The highest strength values showed formulations with HPMC 100M. The mixture of chitosan and Prosolv SMCC 90 had the lowest LSR value, the highest LSR value showed this mixture with 50 % sodium alginate.

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INTRODUCTION INTO THE MAIN IDEAS OF PCA WITH ILLUSTRATIONS FROM PHARMACEUTICAL TECHNOLOGY AND PHARMACOLOGY

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Principal component analysis (PCA) is a mathematical algorithm that helps to reduce the dimensionality of the data while retaining most of the variation in the data set. It accomplishes this reduction by identifying directions, called principal components, along which the variation in the data is maximal.[1] In the context of drug design PCA is used to identify the two principal components and to indicate by visual assessment of the plotted point the influence of the factor on a principal component or on a subset of outcomes. In this presentation we would like to demonstrate the main ideas of PCA on the example of its use in pharmaceutical technology and pharmacology. The first example illustrates the application of PCA in tablet formulation in order to find the influential process formulation parameters and describe their optimal settings.[2] The second example related to pharmacology demonstrates gene expression depending on the clinical/pathological conditions of the placenta. The study was conducted on 177 placenta tissues (39 healthy and 138 pathological divided into subgroups). The parameter of interest is the expression of 16 genes directly involved in placental homeostasis of tryptophan and serotonin. The main aim of the study is to indicate a difference in gene expression between the pathological vs healthy placentas, taking into account the main patient characteristics such as markers of inflammation, fetal sex, fetal weight, BMI etc.

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Thursday 23. January 2020

Lecture hall C

Session 4 - Pharmaceutical Analysis and Bioanalytical Chemistry: *8:30 – 16:30*

Chairpersons: Prof. Marcela Segundo, Prof. Spas Kolev, Prof. Lucie Nováková, Assoc. Prof. Hana Sklenářová

PBA1

DETERMINATION OF URINARY RETINOL AS A NEW POTENTIAL BIOMARKER

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Renal proximal tubule cells are very important for the metabolism and homeostasis of vitamins, especially vitamin A. Some studies show that urinary retinol might be used as an early state biomarker for detection of kidney failure but no clinically useful chromatographic method for simultaneously determination of urinary retinol and creatinine as a urine dilution factor is currently available.[1] Therefore, we developed new UHPLC-UV-MS/MS method using column packed with fluorinated core-shell stationary phase, and acetonitrile with ammonium formate buffer solution as the mobile phase for separation of these two analytes that differ significantly in their physicochemical properties. The method involves very fast and simple sample preparation requiring small amount of sample matrix and solvents. Deuterium labeled internal standard was used for the more precise quantification.[2] The method was tested with real-life samples using urine collected from patients suffering from colorectal or peritoneal cancer, and malignant neoplasm of kidney.

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PBA2

MITOCHONDRIAL ANALYSIS OF HUMAN PLATELETS: COMPARISON OF DIFFERENTIAL CENTRIFUGATION AND CONTINUOUS FLOW APHERESIS

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Using modern high-resolution respirometers (HRR) the analysis of mitochondrial functions and the metabolic profile of platelets (PLT) from a small sample of human blood was made accessible. A standardized isolation procedure for human PLT was developed in the frame of international COST action MitoEAGLE and PLT prepared by this differential centrifugation (DC) secured a high inter-laboratory reproducibility of respirometry results [1]. Continuous flow apheresis (CFA) is a clinical method for PLT isolation aiming for treatment of bleeding diathesis in severe thrombocytopenia with years of good clinical outcomes.

The aim of this project was to introduce a new method of HRR in University Hospital Hradec Kralove and compare mitochondrial respiration of PLT obtained by two different techniques: DC and CFA. HRR was assessed by Oroboros Oxygraph-2k FluoRespirometer (Oroboros Instruments, Austria). According to our preliminary results, the isolation method did not affect maximal respiratory capacity of PLT in this study. PLT isolated by CFA had 30% decrease in succinate oxidation in comparison to DC. Moreover, CFA affected PLT viability. These differences were reversed after washing the PLT by phosphate buffer saline, suggesting possible influence of isolation medium on our results.

We conclude that HRR is a highly sensitive and suitable method to describe the metabolic profile of human PLT. The application of HRR is promising in PLT research in patients with thrombocytopenia, sepsis and metabolic disorders as well as in diagnostics.

The study was supported by Project SVV 260 412, the University Hospital in Hradec Králové MH CZ - DRO (UHHK, 00179906), COST Action CA15203 MitoEAGLE. The loan of Oxygraphs was kindly provided by Oroboros Instruments.

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PBA3

THE METHOD DEVELOPMENT FOR THE DETERMINATION OF CISPLATIN IN HUMAN PLASMA

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Cisplatin is well known for its antitumor activity but it is also associated with side effects, which their relevancy depend on its exposure. Extended exposition can cause nephrotoxicity and other health problems.[1,2] Cytoreductive surgery followed by hyperthermic intraperitoneal chemotherapy is a procedure combining maximal surgical removal of the tumor with intra-operative administration of a chemotherapeutic drug that is heated up. The aim of the whole process is to increase the anticancer effect and minimalize the systemic side effects of the chemotherapy in comparison with systemic chemotherapy.[3]

For the purpose of clinical research, a HPLC method with diode-array detection for the determination of cisplatin in human plasma with simple sample pretreatment has been developed and current results will be discussed. The separation was carried out in 8 minutes using C18 core-shell column with mobile phase consisted of methanol, acetonitrile, and water. As internal standard palladium chloride was used.

The study was supported by SVV 260 412, the University Hospital in Hradec Králové MH CZ - DRO (UHHK, 00179906), and by Ministry of Health of Czech Republic via grant NV18-03-00130.

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PBA4

DEVELOPMENT AND VALIDATION OF UHPLC METHOD FOR THE MONITORING OF TARGET ACTIVE SUBSTANCES AND THEIR RELEASING FROM SOLID DISPERSIONS

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This work is part of a project, that is focused on the development, optimization, and validation of UHPLC methods and their subsequent application on the evaluation of new modern drugs forms based on solid dispersions. The research is based on the development of modern drugs forms, which are using branched polymers as a carrier of active substances with the effort to influence the release of the target drugs and increase their bioavailability. The determination of drug-releasing from the new carrier is for the research crucial. Newly developed chromatographic methods will serve as the main tool for testing various materials used as a carrier of active substances, for the determination of drugs content and detection of possible impurities.

In the presented UHPLC method, miconazole, econazole and its main impurities were chosen as the target analytes. A UHPLC method, using diode-array detection, has been created. A Kinetex^{TM} C18 column, 1.7 μm particle size, 50 x 2.1 mm was used for the separation in combination with the acetate buffer, methanol, and acetonitrile as the mobile phase. Butylparaben was chosen as the internal standard. All substances were detected at a wavelength of 225 nm. The total analysis time was 9 minutes. The new method will be validated and used for testing various branched polymers as a suitable carrier.

The study was supported by SVV 260 412.

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PBA5

IDENTIFICATIONS OF ARTIFICAL MODIFICATIONS INDUCED IN THE COURSE OF LC-MS ANALYSES OF PEPTIDES

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Column temperature is one of the key parameters that remarkably increases efficiency in bot-tom-up LC-MS proteomic analyses. We noticed, however, that at some point, the benefit of elevated temperature to the peak shape is redeemed by lower number of identified peptides. We hypothesized that an in-column peptide degradation might occur when peptides are separated at elevated temperature using acidic mobile phases. To this end, we scrutinized the effect of temperature on the stability of model proteins trapped in a reversed phase column. We confirmed that temperature as high as 45 °C in combination with 0.1% formic acid may al-ready induce on-column peptide bonds cleavage. We subsequently carried out data-dependent LC-MS analyses of tryptic peptides at various column temperatures. We found out that besides in-column peptide bonds cleavage, peptides trapped in a stationary reversed phase may undergo various artificial chemical modifications in the presence of 0.1% formic acid in mobile phases. Additionally, the risk of artificial peptides formylation due to inappropriate sample handling was discovered within the study.

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PBA6

AUTOMATION OF ON-LINE SAMPLE PREPARATION FOR THE PEPTIDE MAPPING ANALYSIS OF BIOPHARMACEUTICALS

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Peptide mapping is critical methodology in routine biopharmaceutical analysis used to confirm identity, characterize primary structure, monitor degradative events, and meet quality assurance[1]. Peptide mapping is the gold standard method for the in-depth study of post-translational modifications (PTMs) of monoclonal antibodies (mAb). PMTs are critical quality attributes defining therapeutic efficacy and safety[2]. Both PTMs and chemical modifications may arise during production, processing, and storage of proteins[1]. Thus, the identification and quantification of PTM is essential in development and analysis of therapeutic biomolecules.

Sample preparation for peptide mapping requires enzymatic digestion of protein that is typically a time-consuming and labor intensive process. It includes several steps prone to operator error that can induce an increase in artificial modifications such as asparagine deamidation[3].

The multidimensional LC system was used for automation of the digestion procedure of trastuzumab to optimize the sample preparation of this mAb prior to peptide mapping. We will describe ongoing project focused on the setup of automated digestion process as a part of multiattribute analysis of mAb. Our study concerns effects of method conditions on the quality of digests of trastuzumab including type and pH of digestion buffer, incubation time, and temperature.

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PBA7

ELECTROCHEMICAL STUDY OF OLIGONUCLEOTIDE PROBES LABELED BY QUANTUM DOTS FOR THE DETECTION OF BACTERIAL AND VIRAL PATHOGENS

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African swine fever virus (ASFV) is a virus, with high morbidity and mortality, which is infectious for domestic and wild pigs and causes serious socioeconomic impact[1]. Because of the non-existence of suitable vaccine, it is necessary to determine the presence of the virus directly in the focus of infection. Thus, the cornerstone of design of a biosensor for rapid analysis of ASFV was suggested. This work is focused on the electrochemical study of oligonucleotides (ODNs) KING R and KING F which are specifically complementary to ASFV DNA, and quantum dots (CdTe QDs) as a label for these ODNs. The adsorptive transfer technique was used for the accumulation of ODNs to a working electrode. In the first phase, the dependences of the current on concentration and time of accumulation of ODNs were measured. The calibration ranges from 0.4 to 1.7 $\mu g \cdot mL^{-1}$ for KING F and 0.1 to 0.6 $\mu g \cdot mL^{1}$ for KING R were measured and the LODs, LOQs and CVs were calculated. CdTe QDs interacted with ODNs. CA (cytosine and adenine) signals of ODNs were 33.9 ± 8.7 nA and 22.0 ± 3.3 nA for KING F and KING R, respectively. For interaction CA signals were detected as follows: KING F/QDs 15.8 ± 8.6 nA, KING R/QDs 16.1 ± 5.1 nA and cadmium signals were detected as follows: KING F/QDs 61.8 ± 15.7 nA and KING R/QDs 89.3 ± 18.2 nA. This study brought pilot results for the creation of biosensor for detecting bacterial and viral pathogens, which can be useful for the suggestion of suitable pharmaceutical therapy.

The study was supported by the EU programme for education, training, youth and sport ERASMUS+ and project AMOR QK1920113.

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PBA8

LC-MS/MS STUDY OF FIRST PHASE IN-VITRO BIOTRANSFORMATION OF NEW PROMISING TACRINE DERIVATIVES

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Alzheimer's disease is a neurodegenerative disorder causing decline in cognitive functions, gradual loss of self-control, development of disorientation, and afterwards motoric failure. Current symptomatic pharmacotherapy is primarily focused on acetylcholinesterase inhibitors and NMDA (N-methyl-D-aspartate) receptor blocking.[1] Tacrine molecule, which is one of the acetylcholinesterase inhibitors, was withdrawn from the market due to the hepatotoxicity of its metabolite 7-hydroxytacrine in 2013. The substitution of tacrine molecule may potentially block the formation of toxic metabolites. The introduction of methoxy group to position of 7 the 1,2,3,4-tetrahydroacridine led to 7-methoxytacrine.[2]

The aim of our work was to determine the metabolites of tacrine and 7-methoxytacrine and to evaluate the effects of biotransformation in *in vitro* study. Human liver microsomes (HLM) were used as first phase *in vitro* biotransformation model and HPLC coupled with Q Exactive Plus mass spectrometer was used for the characterization of metabolites.

The new HPLC-MS method for the separation and identification of tacrine and 7-methoxytacrine metabolites was created and structures of metabolites were experimentally designed from Full-MS and MS/MS spectra and confirmed by MassFrontier (MetWorks).

The results of the study show that the main way of biotransformation of both compounds is their monohydroxylation and dihydroxylation. Moreover, several novel *in vitro* metabolites of tacrine and 7-methoxytacrine which have not been reported in the literature so far were found and the relative proportion of individual metabolites was calculated.

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PBA9

ANALYSIS OF ECCRINE SWEAT

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While sweating is usually found unpleasant and annoying it is very important mechanism that provides our bodies with effective temperature control in different situations. Also its composition can be influenced by various substances or state of health. There are two main types of human sweat. Apocrine sweat consists of predominantly lipophilic substances and eccrine sweat, which could be described as a hydrophilic, consists mainly from water and various ions and small amount of other substances[1]. Our research focuses on eccrine sweat and these substances. Sweat is collected by patches worn for one week. Then the patch is collected and extracted and extracts is lyophilised. The samples are then analysed by HPLC coupled with mass spectrometry. As the majority of metabolites are hydrophilic HILIC column was used to at least partially separate them. The analysis was performed in both positive and negative modes. In this initial state we have processed only a small amount of patches, which are considered healthy controls for future research.

The study was supported by MH CZ - DRO (UHHK, 00179906)

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PBA10

ION MOBILITY SPECTROMETRY IN DOPING ANALYSIS

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This project aimed to examine the effects of using ion mobility spectrometry – mass spectrometry in doping control analysis using 194 compounds from World Anti-Doping Agency prohibited list, including stimulants and narcotics (Class I) and anabolic steroids, glucocorticoids, and hormones (Class II). MS^e data independent acquisition scan type with high-resolution mass spectrometry was used for the experiments. The analyses were carried out using q-TOF (quadrupole-time of flight) with and without activation of the ion mobility spectrometry dimension. The ultra-high-performance liquid chromatography- mass spectrometry method was developed using standard mixtures to tune the settings of mass spectrometer and to optimize the data processing method. Subsequently, the method was used with urine samples prepared by dilute and shoot approach for Class I and by supported liquid-liquid extraction (SLE) for Class II. Prior to the analysis, SLE procedure was optimized to ensure sufficient sensitivity with final pre-concentration by factor of 10. Finally, the analyses of standard doping agents and urine samples were compared with and without ion mobility function, including the comparison of collision cross section (CCS) values, fragmentation, and quality of spectra. The robustness of the method was proved by intraday, interday, and interweek repeatability of retention times and CCS values, providing RSD values always lower than 2 %. The effect of matrix on CCS values was examined as well as matrix effects and fulfillment of minimum required performance limits. The effect of ion mobility on the quality of spectra, elimination of interferences, and method sensitivity was evaluated with the aim to improve screening capabilities, especially to prevent false positive and false negative results.

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PBA11

STUDY OF INCREASING SENSITIVITY IN ESI$^-$ BY ANION ATTACHMENT

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Increasing detection sensitivity is crucial task in LC-MS method development. Apart from the instrument limits, ionization efficiency is the key to good sensitivity. In case of poorly ionized analytes, alternative LC-MS mobile phase additive can be considered. Besides conventional volatile acids and buffers enhancing deprotonation of analytes in ESI$^-$ and increasing conductivity, the ionization can be achieved by adduct formation or through gas phase proton-transfer reactions.

For this study, ammonium fluoride was selected as anion attachment additive for its strong gas-phase proton affinity. Generally, signal improvement of less polar molecules can be provided by an anion attaching to electropositive region of analyte molecule forming an adduct. Fluoride anion, due to higher gas-phase basicity than most of other anions and deprotonated molecules, is able to abstract the shared proton from the analyte and separate as HF. Finally, ionization efficiency is enhanced by production of $[M-H]^-$ in gas phase.[1]

Mobile phase containing ammonium fluoride (0.1-1mM) was compared to conventional additive 0.1% formic acid and its positive effect on signal intensity was assessed for broad spectrum of compounds varying in molecular weight, polarity, lipophilicity, and structures. Fluoride anion attachment potential as a solution for increasing sensitivity in ESI$^-$ is going to be discussed.

The study was supported by the STARSS project (Reg. No. CZ.02.1.01/0.0/0.0/15_003/0000465) co-funded by ERDF.

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PBA12

MODIFICATION OF CAPILLARY WALL BY GRAPHENE FOR SEPARATION IN CAPILLARY ELECTROPHORESIS

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Graphene (G) is two-dimensional sp^2 single-atom-thick carbon sheet with hexagonal structure. High specific area (theoretical value 2630 m^2 g^{-1}) together with the affinity to carbon ring structures via π-π stacking interactions make G and graphene oxide (GO) promising candidates for application in analytical chemistry.[1, 2]

Our work aims on the modification of the inner surface of bare silica capillary by Layer-by-Layer method (LbL).[3] LbL is very simple self-assembly procedure which controls through electrostatic interactions adsorption of negatively charged GO onto wall covered by positively charged polyelectrolyte. Modification of capillary wall by GO is believed to substantially improve the separation properties for analysis of charged/neutral analytes due to the combination of the high CE efficiency and additional interactions with the modified surface. As it is difficult to characterize and optimize a nanoscale coating, the deposition was firstly done on the flat surface (silicon wafer or quartz slide) and different technique (ellipsometry, UV-Vis spectroscopy, AFM) were employed. Different combinations of polyelectrolyte/GO were tested. Based on these results, the coating process was transferred into the capillary and the separation of the model analyte mixture was compared with unmodified capillary.

The study was supported by Dean's fund (PROGRES Q42).

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PBA13

ANALYTICAL STUDY OF THE INFLUENCE OF EXPERIMENTAL CONDITIONS ON THE CHIRAL SEPARATION OF BORON CLUSTER COMPOUNDS

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Boron clusters are artificial compounds which create 3D-cage structure and exhibit unique physicochemical properties. Carboranes are prepared by substituting BH units for CH units. They are studied as stereoselective catalysts, monomers for thermostable polymers and in medicine as compounds which enhance the effectivity of boron neutron capture therapy. Steric similarity with rotating phenyl ring enables extensive research of carboranes as new pharmacophores.[1]

Chirality of boron clusters is caused by introducing endo-/exoskeletal substituents, which impair the symmetry of the cage. Due to the chiral character of these compounds, it is vital to evaluate the influence of experimental conditions on chiral separations with respect to their potential use.

Even though zwitterionic carboranes were successfully separated on native beta-cyclodextrin based chromatographic columns, attempts to separate anionic carboranes were unsuccessful.[2] On the other hand, native beta-cyclodextrins were able to resolve some anionic carboranes in capillary zone electrophoresis.[3] To clarify this contradiction, chromatographic behavior of anionic carboranes was tested on a native beta-cyclodextrin column (ChiraDex, Merck).

Our work aims to elucidate the discrepancy between chiral separations of anionic carboranes by high performance liquid chromatography and capillary zone electrophoresis.

The study was supported by SVV 260 401.

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PBA14

LC-MS/MS INVESTIGATION OF CARDIOPROTECTIVE DRUGS

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Current anticancer therapy with anthracyclines is, despite its efficiency, limited due to the high risk of cardiotoxic effects. Up-to-date, the only clinically approved cardioprotective agent is dexrazoxane (DEX). Its novel analogue, JAS-2 [4,4'(Butane-2,3-diyl)bis(piperazine-2,6-dione)], exerts greater efficiency *in vitro* (neonatal rat cardiomyocytes model) when compared with DEX. Previously, UHPLC-MS/MS method for determination of JAS-2, its metabolite JAS-2_{met} and its pro-drug with a code name GK-667 was employed in our laboratory using UHPLC system (Nexera, Shimadzu) coupled with a triple quadrupole mass spectrometer (LCMS-8030, Shimadzu). Although this method was successfully applied on *in vitro* stability study on GK-667 and JAS-2 in plasma and DMEM medium, its use in pilot *in vivo* pharmacokinetic study was limited in terms of low sensitivity to GK-667 and JAS-2_{met}. Besides the attempts to enhance the recovery of these analytes by modification of the sample preparation step (i.e. precipitation with methanol), new LC-MS/MS method for determination of JAS-2 and its metabolite in plasma carried on LC system (1290 Infinity II, Agilent) coupled with a triple quadrupole mass spectrometer (Triple Quad LC/MS 6400 series, Agilent) was developed. Chromatographic separation of JAS-2 and JAS-2_{met} was performed on Luna Omega Polar column (100 x 3.0 mm, 2.5 μm, Phenomenex) using gradient elution system consisting of 1mM ammonium formate and methanol. The presented method led to achievement of the LLOQ at the level of 0.01 μM for both analytes, which is 20 times lower than the former procedure. Increased sensitivity enabled determination of JAS-2 and JAS-2_{met} in plasma of rabbits administered with GK-667 (5mg/kg, i.v., n=8).

The study was supported by Dean's fund (PROGRES Q42), Czech Science Foundation (project 18-08169S).

PBA15

MONITORING INFLUENCE OF PESTICIDE SPRAY ON ANTIOXIDANTS IN APRICOTS

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Pesticides are substances used in agriculture to control pests and weeds. Their use is controlled, and the highest toxicologically acceptable amount of each pesticide is determined by maximum residue level. Apricots are valuable source of phytonutrients, substances with antioxidant properties, in human diet. Amount of these substances is influenced by cultivar type, harvest time, storage, processing, etc. For the presented study, ´Betynka´ apricot cultivar grown in orchards of Research and Breeding Institute of Pomology in Holovousy, was used.

This study focuses on influence of pesticide spray type applied in permitted level on nutritional properties of apricots regarding phenolics content and potential antioxidant properties. Effect of pesticide spray type was studied in fresh fruits and fruits stored for 10, 20, and 30 days after harvest in ultra-low oxygen warehouse. HPLC separation with diode array detection (DAD) was used to monitor content of 17 selected phenolic substances typically present in apricots. Moreover, HPLC with 8-channel electrochemical coulometric detector (CA) was used for evaluation of overall content of reducing agents, and Trolox equivalent antioxidant capacity assay (TEAC) for evaluation of radical scavenging activity of methanolic apricot extracts.

Results of phenolics determination and antioxidation activity in fresh and stored fruits with individual pesticide spray type obtained by HPLC-DAD, HPLC-CA, and TEAC methods were compared with control sample, without pesticide spray application. For statistical evaluation of the effect of applied pesticide spray on nutritional properties of fresh and stored apricots, ANOVA with repeated measures was applied on results obtained by HPLC-DAD. Based on the comparison, samples of tested spray types and control sample significantly differ from each other, considering the spray type and storage period.

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PBA16

COMPARATIVE STUDY OF VARIOUS SORBENTS FOR DETERMINATION OF OCHRATOXIN A AND OCHRATOXIN B IN ARCHIVE TOKAJ WINES USING ON-LINE SPE-HPLC

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Various sorbents for on-line extraction and determination of ochratoxin A (OTA) and ochratoxin B (OTB) in archive Tokaj wine have been compared. Tokaj wine is a special type of sweet wine from grapes infected with mould *Botrytis cinerea* produced in Hungarian Tokaj wine region and in Slovakia. Our method involved on-line extraction using precolumn coupled to liquid chromatography with fluorescence detection and enabled fast and sensitive control of mycotoxin contamination. Four types of fibrous sorbets including polyethylene microfibers, polypropylene microfibers, polycaprolactone microfibers/nanofibers composite, and polycaprolactone microfibers/polyvinylidene difluoride nanofibers composite, typical fused-core C18 sorbent, and commercial molecularly imprinted polymers were compared while varying extraction approaches. The polymer fibers filled in a cartridge were directly connected to HPLC system and the clean-up efficiency and the subsequent chromatography separation optimized. Typically, 50 µL wine was directly loaded and preconcentrated in extraction column. The separation was then carried out using analytical column Kinetex Phenyl-Hexyl (100 × 4.6 mm, particle size 2.6 µm) followed by fluorescence detection (Ex 335 nm, Em 463 nm). Solvents suitable for extraction and separation were methanol or acetonitrile and 0.5% aqueous acetic acid. The separations were carried out in the gradient elution mode at a flow rate of 1.0 $mL.min^{-1}$. These conditions provided reliable validation results with a limit of detection of 0.03 – 0.06 $\mu g.L^{-1}$ and recoveries exceeding 90% were determined for both OTA and OTB in archive Tokaj wines. The maximum tolerable limit for OTA in wines authorized by the European Union is 2 $\mu g.L^{-1}$. Among the tested nanofibers, polyethylene enabled the best results while other nanofibrous materials are unsuitable for the analysis of ochratoxins. Comparable results were obtained using molecularly imprinted polymers, fused-core C18, and polyethylene microfibers. However, the last sorbent excels in the affordability. A more detailed comparison of sorbents will be presented.

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PBA17

PEAR TREES MATERIAL AS A RICH SOURCE OF IMPORTANT PHENOLIC COMPOUNDS

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The aim of the study was to determine a spectrum of phenolic compounds and their content in pear trees – leaves, bark, buds, stems, floral ovaries, blossom and also in fruit and seeds. The methanol extracts were obtained from raw material of different pear tree cultivars. Extracted phenolic compounds – arbutin, chlorogenic acid and it´s derivates (1,5 and 3,5-di-caffeoylquinic acid) and rutin were analyzed by high performance liquid chromatography. Finally, ASCENTIS Express RP-Amide 150×4.6 mm, particle size 2.7 μm analytical column was used for analysis due to ability to separate both derivates of chlorogenic acid. Column temperature was 30 °C and injection volume was 1 μl. The separation was performed with gradient elution at flow rate 1 ml/min and analysis time 10.50 min. The mobile phase consisted of acetonitrile and 0.1% phosphoric acid. The detection was carried out at wavelengths 220, 327, 354 nm. The method was validated before the quantification of phenolic compounds in the leave extracts with following parameters: the linearity (R^2 = 0.997-0.999), repeatability (RSD = 0.49-3.09 %), recovery (88.66-114.26 %) and precision (RSD = 0.77-2.87 %). The following concentration range of total content expressed in mg/g of dry mass in defined extracts were obtained: leave extracts (22.62-54.80 mg/g), bark extracts (17.44-55.18 mg/g), bud extracts (14.24-31.93 mg/g), stem extracts (55.00-74.04 mg/g), ovary extracts (50.26-87.60 mg/g) and blossom extracts (38.04-62.83 mg/g). The concentration of evaluated phenolic compounds occurring in fruit and seeds extracts was significantly lower. Arbutin and chlorogenic acid were found as a major component. This research revealed that pear trees material is rich source of phenolic compounds and could be potentially used for further using.

The study was supported by TAČR Zéta project no. TJ02000196 – "Research using of fruit tree waste as a source of valuable bioactive substances". A. Adamcová gratefully acknowledge the financial support of the project no. SVV 260 412.

PBA18

POLYMER INCLUSION MEMBRANE (PIM)-COATED MAGNETIC STIRRER BAR FOR THE PRECONCENTRATION OF SULFAMETHOXAZOLE

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Sulfamethoxazole (SMX) belongs to the group of emerging organic contaminants, which may accumulate in natural waters causing environmental concern.[1] Its monitoring is thus very important. However, the levels of SMX present in natural waters is often very low (ng L^{-1} to μg L^{-1}) and for that reason its analysis consist of a challenge. The aim of this deals with using of magnetic stirrer bars coated with polymer inclusion membranes (PIMs) for the separation and preconcentration of SMX from natural waters. Initially the analyte is selectively retained within the PIM via ion-exchange by stirring the coated magnetic bar in the natural water sample. Following step is dipping the loaded PIM-coated stirrer bar in a smaller volume of a stripping solution to remove the SMX back to an aqueous solution for further analysis. Different types of base polymers, namely cellulose triacetate (CTA), polyvinyl chloride (PVC) or poly(vinylidene fluoride-co-hexafluoropropylene) (PVDF- HFP) were tested for the fabrication of the PIM coating, while Aliquat 336 as used as the extractant. 1-tetradecanol and 2-nitrophenyloctyl ether (NPOE) were used as the modifier or plasticizer, respectively.

This study involves important PIM optimizations, particularly testing of different concentrations of casting solutions and the number of dips into the casting solution required to prepare a sufficient layer of PIM on the stirrer bar surface. Preliminary experiments revealed that the optimum PIM thickness that facilitates the fastest extraction rates is 20 μm, which corresponds to a variable number of dips depending on the PIM composition.

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PBA19

CARBON DIOXIDE EXPANDED LIQUID AS A SOLVENT FOR THE EXTRACTION OF QUERCETIN FROM PLANT MATERIAL

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Supercritical fluid extraction (SFE) using non-polar CO_2 as an extraction solvent is commonly used approach to extract bioactive compounds from natural sources such as dried leaves, herbs, fruits, and flowers. Neat CO_2 is an optimal choice to extract non-polar compounds. Thus, an organic solvent is often added to CO_2 to achieve extraction of more polar compounds. Methanol, ethanol (EtOH), isopropanol, and small water proportion are usually added to change polarity, mass transfer, extraction yield, and analytes solubility. Depending on the amount of added organic solvent, we recognize SFE, SFE with modifier, CO_2 expanded liquid extraction, and pressurized liquid extraction. Other parameters including temperature, pressure, and type of extraction can also improve the extraction yield. In our study, we optimized method for the extraction of quercetin from quince fruit. Placket-Burman model was used to determine the effect of addition of 0- 20 % water in EtOH as a green organic solvent added to CO_2 in ratio 10 – 90 %. We used temperatures in a range of 30 – 80 °C and a pressure of 100 – 300 bar. After its evaluation, the water amount in ethanol was set up on 20% due to low effect of this parameter. The tested ranges were consequently narrowed for other parameters using design of experiment. Then, 4 different flow rates in a range of 1-4 mL min^{-1} were explored to find the final extraction conditions. Optimized method used CO_2/EtOH + 20% H_2O (10/90, v/v) at 66 °C, pressure of 223 bar, and flow rate of 4 mL min^{-1}. These conditions enabled extraction of quercetin in 30 min with recoveries of 120 ng (22% RSD, n=9, 3 different days) from 0.5 g sample.

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PBA20

3D-PRINTED MAGNETIC STIRRING CAGES FOR THE EXTRACTION OF BISPHENOLS FROM WATER USING MICRO- AND NANOFIBERS

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Electrospun nanofibers are currently in the focus of analytical chemists for their great potential as a sorbent in solid phase extraction techniques[1]. Apart from that, 3D printing nowadays holds a stable position in many areas of human activities including analytical chemistry due to the possibility of fast prototyping[2].

Using the 3D printing technology "Fused Deposition Modelling", we designed a cage-like holder with integrated magnetic stirring bar. The cage allowed accommodating up to 60 mg nano-polycaprolactone/micro-polycaprolactone fibers as a lose package for sorbent extraction. The device was immersed into 100 mL sample and was allowed to stir for 50 min for the extraction of eight bisphenols from natural waters. The analytes were then stripped using 5 mL methanol during 35 min. The limits of detection and quantitation were between 0.1 - 2.1 μg L^{-1} and 0.4 - 7.0 μg L^{-1}, respectively. The average analyte recovery at 50 ppb spike level was 99.0% ± 7.0%.

This work was supported by the STARSS project (Reg. No. CZ.02.1.01/0.0/0.0/15_003/0000465) co-funded by ERDF. The authors also acknowledge the support of the Czech Science Agency through project No. 20-19297S.

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PBA21

BIOMIMETIC CRYSTALLIZATION OF METAL ORGANIC FRAMEWORK FOR THE PREPARATION OF HYBRID MONOLITH IN CAPILLARY FORMAT FOR THE SELECTIVE EXTRACTION OF DRUGS

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Organic polymer monoliths are excellent supports for the chromatographic separation of large molecules. Monolithic columns feature high permeability and low back pressure. However, they suffer from a rather small surface area needed for the separation of small molecules. On the other hand, porous metal-organic framework (MOF) crystals are highly porous with widely tunable properties. Unfortunately, their packing in separation columns is challenging due to their small particle size and non-spherical shape. Therefore, we designed a new generation of separation media combining advantages of organic polymer monoliths and MOF while reducing their drawbacks. We prepared polydivinylbenzene monolith containing ZnO nanoparticles as the MOF metallic precursor. ZnO nanoparticles were then converted to zeolitic imidazolate framework ZIF-8 via biomimetic crystallization using 2-methylimidazole as the organic linker with addition of a bioactive molecule - amino acid - that enabled further modulation of MOF size and increased its selectivity. L-histidine, L-valine, phenylalanine, and glutamic acid were selected for our experiment and their effects on crystal morphology and adsorption selectivity were demonstrated. In situ polymerization time, and MOF crystals growth, were optimized to create open tubular capillary columns for enantioselective solid phase microextraction. Chiral selectivity and extraction capacity of the material were studied with batch extraction of propranolol enantiomers.

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PBA22

COMBINING LAB-IN-SYRINGE WITH BEAD-INJECTION FOR PRECONCENTRATION OF NONSTEROIDAL ANTI-INFLAMMATORY DRUGS IN SURFACE WATERS COUPLED ONLINE TO HIGH PERFORMANCE LIQUID CHROMATOGRAPHY

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The modern flow techniques Lab-In-Syringe (LIS) and Lab-On-Valve (LOV) were combined and hyphenated to high-performance liquid chromatography for online micro-solid phase extraction of 5 nonsteroidal anti-inflammatory drugs (NSAID), namely ketoprofen, naproxen, flurbiprofen, diclofenac, and ibuprofen. The combined system ensured adequate mixing of large volume of sample with buffer inside the syringe enabling higher enrichment than typically achieved by simple LOV. SPE on a micro-SPE, packed automatically and in-system following the Bead Injection principle, was carried out in the LOV conduit using 4.4 mg of Oasis HLB® sorbent of particle size 30 μm for each sample analysis. Parameters such as injection volume, volume of sorbent suspension, ionic strength of buffer and the elution and loading flow rates were optimized. After washing the micro-SPE column with water to remove any unretained matrix components, the retained analytes were eluted with acetonitrile: water (50:50%(v/v)) and 350 μL of the eluate loaded into the HPLC injection loop. Separation of 5 NSAID was done on a Symmetry C18 column (4.6 x 150 mm, 5 μm) and C18 OPTI-GUARD® 1 mm guard column using a mobile phase of 30% (v/v) acetonitrile and 30%(v/v) methanol in 25 mmol/L ammonium formate buffer, pH 3.5, in isocratic regime. The method developed was reproducible with RSD values of 1 % to 7 % on 20 μg/L level with linear range of 10 μg/L to 200 μg/L and LOD less than 5 μg/L. Recovery factors between 91 to 109 were obtained for surface water samples at 20 μg/L level.

The study was supported by specific research 260 412/2019.

PBA23

POLYSULFONE MEMBRANE ENRICHED IN BIOACTIVE COMPOUNDS TO REDUCE OXIDATIVE STRESS AND INFLAMMATION IN DIALYSIS PATIENTS

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Oxidative stress (OS) and chronic inflammation are commonly present in dialysis patients, due to frequent contact of patients´ blood with artificial membrane. To reduce oxidative stress, vitamin E-coated membranes are used to scavenge the reactive oxygen species formed during the hemodialysis. Although the use of this type of membrane showed diminishment in some inflammatory and OS markers [1], the overall beneficial effect on mortality is still uncertain.

The aim of our work was to evaluate, if the enriched polysulfone (PSf) membranes with other bioactive substances, such as antioxidant lipoic acid or synthetic inhibitors of neutrophil elastase, could have preferable impact on OS and/or inflammation than vitamin E. Lipoic acid was incorporated in PSf membranes alone or together with vitamin E, while synthetic elastase inhibitors were immobilized on the membranes surface through adsorption. The biological activity and biocompatibility of the modified membranes were studied *in vitro*. Both types of bioactive compounds immobilized on PSf membrane showed promising effect on diminishment of OS/inflammation and therefore could be considered for future treatment.

The study was supported by the Charles University Grant Agency, project no. 860216 and by project no. SVV 260412 of specific research of Charles University. Further was supported by EFSA-CDN (CZ.02.1.01/0.0/0.0/16_019/0000841) co-funded by ERDF; FCT/MEC (PT2020 UID/QUI/50006/2019); FCT/MCTES (UID/QUI/50006/2019) project (CCDR-N) /NORTE2020/Portugal 2020 (Norte-01-0145-FEDER-000024); PTDC/MEC-CAR/31322/ 2017.

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PBA24

LIQUID-PHASE MICROEXTRACTION OF ORGANOPHOSPHORUS PESTICIDES USING SUPRAMOLECULAR SOLVENT AS A CARRIER FOR FERROFLUID

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Supramolecular solvents (SUPRASs) are water immiscible nano-structured solvents composed of 3D amphiphilic aggregates, which have been used in microextraction procedures. The most important feature of supramolecular solvents is their high solvation potential for a wide range of target analytes (both polar and non-polar ones). As collecting of extracting solvent is of great importance in the liquid-phase microextraction, ferrofluids–suspended magnetic nanoparticles in a carrier liquid-can overcome the drawbacks such as centrifugation and refrigeration. In this study, we used supramolecular solvent as a carrier for ferrofluid and extracted three organophosphorus pesticides (OPPs) in water and fruit juice samples. To this end, oleic acid coated magnetic nanoparticles were prepared to omit the centrifugation step and they were used in combination with SUPRAS in the extraction process. The influence of main variables on the extraction efficiency was investigated using response surface methodology (RSM) based on central composite design (CCD). Under the optimum experimental conditions, the resulting calibration curves were linear in the concentration range of 0.5-400 μg L^{-1}. The intra-day and inter-day precisions were evaluated to be in the range of 2.0-5.3 % and 2.6-5.7 %, respectively. The obtained limits of detection (LODs) also ranged from 0.1 to 0.35 μg L^{-1}.

The study was supported by the research council of Razi University, (Faculty of Chemistry, Razi University, Kermanshah, Iran).

Lecture hall B

Sessions 5 and 6 - Biochemistry, Pharmacology and Toxicology

morning: 8:00 – 12:00
Chairpersons: Prof. Daniel Scherman, Prof. Petr Pávek, Assoc Prof. Martina Čečková

afternoon: 12:30 – 17:45
Chairpersons: Prof. Des Richardson, Prof. František Štaud, Prof. Barbora Szotáková, Assoc Prof. Lukáš Červený

PXFL1

IN VITRO SCREENING OF STRUCTURALLY DIFFERENT TOPOISOMERASE II INHIBITORS FOR PREVENTION OF ANTHRACYCLINE CARDIOTOXICITY

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Anthracyclines (ANTs) retain the prominent role in many cancer treatments due to their high efficacy. However, the use of all of the ANTs is associated with a risk of severe cardiotoxicity. To date, dexrazoxane (DEX) has been the only cardioprotective agent approved for clinical use; therefore, it represents the main lead in the search for effective cardioprotection. The focus regarding its cardioprotective mechanism has recently shifted from metal chelation to its effect on topoisomerase II (TOP2).

This inspired us to examine various structural types of compounds described as TOP2 inhibitors for potential cardioprotective effect. In the first stage, we screened a series of commercially available compounds reported to inhibit TOP2 for their protective properties on primary cultures of neonatal rat cardiomyocytes. We also examined the effects of studied compounds on proliferation of HL-60, cell line derived from acute promyelocytic leukemia, and their effect on antiproliferative activity of daunorubicin. Because mitigation of adverse effect loses meaning if it diminishes the main effect.

From the series of inhibitors evaluated so far, three compounds show promising cardioprotection. Therefore, in the next stage, effect of the selected compounds on activity and depletion of TOP2 will be ascertained, to gain better mechanistical insight; and also, analogues of the perspective compounds are being prepared and studied.

This study was supported by the Charles University (project 246219) and project InoMed (NO.CZ.02.1.01/0.0/0.0/18_069/0010046).

PXFL2

EVALUATION OF DAUNORUBICIN ANTIPROLIFERATIVE EFFECT ON TOPOISOMERASE 2B DEPLETED HL-60 GENERATED WITH CRISPR-CAS9

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Topoisomerase II β (TOP2B) inhibition was identified as one of the possible mechanisms of dexrazoxane protection of cardiomyocytes from anthracycline (ANT) cardiotoxicity. In 2012, Zhang et al. outlined that mice with heart specific depletion of TOP2B were prevented from ANT-induced cardiac damage.[1] Unlike heart cells, human leukemic cell line HL-60 contain both TOP2A and TOP2B isoforms. TOP2A enables cell division while the precise function of TOP2B was not fully understood yet. Dexrazoxane (DEX) as the only approved cardioprotective agent acts as catalytic inhibitor of both TOP2 isoforms, and due to its TOP2 inhibition effect is suspected of compromising the cytotoxicity effect of anthracyclines in cancer cells. The TOP2B was also implicated in the resistance of tumor cells and the increase of secondary malignances, we aimed to deplete TOP2B with CRISPR-Cas9 technology and evaluate the effects of daunorubicin (DAU) on these mutants regarding their sensitivity to DAU. HL-60 were transfected with specific CRISPR-Cas9 plasmid targeting TOP2B. Forty-eight hours after transfection the cells were sorted with GFP as a selection marker to 96-well plates. After approximately 6 weeks of cell growth individual clones were tested for TOP2B occurrence by immunofluorescence and western blotting. TOP2B deficient clones were spotted and genotyped to characterize individual clonal mutations. Based on these acquired data several homozygous and heterozygous TOP2B deficient mutants were identified. Antiproliferative effect of DAU was evaluated in both homozygous and heterozygous mutants using MTT.

The study was supported by SVV 260 416.

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PXFL3

TYROSINE KINASE INHIBITORS AS MULTITASKING SOLDIERS AGAINST CANCER DRUG RESISTANCE: THE EXEMPLARY CASE OF MIDOSTAURIN

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Tyrosine kinase inhibitors (TKIs) are proven active antileukemic agents that suppress aberrant tyrosine kinase signaling involved in cell proliferation. TKIs have shown additional targeting of proteins involved in cancer multidrug resistance, like membrane transporters and detoxifying enzymes. Midostaurin is a selective inhibitor of FMS-like tyrosine kinase-3 (FLT3) approved for the treatment of acute myeloid leukemia (AML), in combination with anthracycline daunorubicin (DAU). Midostaurin-based combination chemotherapy has demonstrated significant clinical benefits and safety, but the molecular mechanisms involved are still poorly understood. In this sense, there has been reported how carbonyl reducing enzymes (CREs) expressed in leukemic cells contribute to resistance towards daunorubicin. In this context, we evaluated the effect of midostaurin on DAU reduction by several recombinant CREs, observing a tight-binding inhibition of Aldo-keto reductase 1C3 (AKR1C3). Likewise, midostaurin decreased DAU metabolism in an HCT116 cell model overexpressing AKR1C3. Furthermore, acute myeloid leukemia cell line KG1a naturally expresses CREs that correlates to its inherent resistance to anthracyclines. Midostaurin performs a dual effect on KG1a cells, by inducing DAU accumulation but significantly reducing DAU metabolism. Confocal microscopy and flow cytometry showed that the combination with midostaurin increases the nuclear localization of daunorubicin in KG1a cells, probably due to the higher availability of the non-reduced form of DAU. Our findings revealed that midostaurin improves DAU cytotoxicity by the simultaneous inhibition of different proteins that are critical in cancer multidrug resistance.

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PXFL4

EMD1214063 REVERSES MULTIDRUG RESISTANCE BY INHIBITING THE EFFLUX FUNCTION OF ABCB1 AND ABCG2 TRANSPORTERS

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ABC (ATP-binding cassette) drug efflux transporters play an important role in pharmacokinetic drug-drug interactions as well as in the phenomenon of multidrug resistance (MDR) in cancer cells. EMD1214063 (EMD) is a novel c-MET tyrosine kinase inhibitor that has being developed for several types of cancer, including non-small cell lung cancer. In this study, we aimed to evaluate the inhibitory activity of EMD towards human ABC transporters and its role in the MDR. In accumulation studies in MDCKII cell lines overexpressing particular ABC transporters, we showed that EMD is an inhibitor of ABCB1 and ABCG2. Furthermore, we demonstrated that EMD1214063 significantly reverses ABCB1- and ABCG2-mediated daunorubicin and mitoxantrone MDR, respectively. For reversal experiments, MTT proliferation assay in MDCKII, A431 and HL60 cells overexpressing ABCB1 and ABCG2 transporters, was used. Additionally, EMD was found to be a substrate of ABCB1 but not of ABCG2 or ABCC1, in MDCKII monolayer transport assays followed by UHPLC/MS analysis. No significant induction effects of EMD on ABCB1, ABCG2 or ABCC1 mRNA levels were found in physiological cells as well as non-small cell lung cancer cellular models using qRT-PCR analysis. Overall, we conclude that EMD could participate in the pharmacokinetic drug-drug interactions and overcome the pharmacokinetic MDR phenomenon in cancer cells. Future in vivo confirmation of our results might potentially open the way for the establishment of safe and effective combination pharmacotherapy for many oncological patients.

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PXFL5

MIDOSTAURIN AS A NOVEL MODULATOR OF ABC TRANSPORTERS IN ACUTE MYELOID LEUKEMIA

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Midostaurin is a multi-kinase inhibitor recently approved for the treatment of patients diagnosed with acute myeloid leukemia (AML) or myelodysplastic syndrome, who carry the FMS-like tyrosine kinase 3 (FLT3) mutation accountable for a poor prognosis. One of the most common mechanisms responsible for a failure of anticancer therapy is multidrug resistance (MDR) with ABC efflux transporters being one of important causative factors. Specifically ABCB1 and ABCG2 are confirmed to be related to resistant $CD34^+$ leukemic blast cells. In this study we aimed to evaluate interaction of midostaurin with ABC transporters using resistant HL60 cell lines and *ex vivo* isolated peripheral blood monocyte cells (PBMC) from patients *de novo* diagnosed with AML. Gene expression of ABC transporters was established in AML patients' PBMC employing droplet digital PCR. Our results showed that *ABCB1* and *ABCG2* were highly expressed in $CD34^+$ cells while differences between $FLT3^+$ and $FLT3^-$ patients fell short of statistical significance. Accumulation assays in resistant HL60-ABCB1 and HL60-ABCG2 cells revealed midostaurin as inhibitor of both transporters. When applied to PBMC of $CD34^+$ patients, midostaurin significantly increased the intracellular levels of mitoxantrone, a conventional anticancer drug that is recognized as a substrate of ABC transporters. Since a noticeable correlation of *ABCB1* and *ABCG2* expression with the effect of midostaurin on accumulation of mitoxantrone in PBMC was found, we can assume that the expression of ABC transporters might affect therapeutic outcomes of combination therapy in AML. In conclusion, we show here the potential of midostaurin to contribute to overcoming the pharmacokinetic MDR in AML patients and thereby prevent the pharmacotherapy failure.

The study was supported by SVV 260 414 and PRIMUS 20/MED/010.

PXFL6

OVERCOMING DAUNORUBICIN RESISTANCE MEDIATED BY ALDO-KETO REDUCTASE 1B10.

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Tyrosine kinase inhibitors (TKi) have been found to have effective antitumor activity and have been approved or are under clinical trials [1]. Recent studies show that some TKis are able to enhance the cytotoxicity of anthracyclines [2]. Dasatinib is an orally administered, small-molecule inhibitor of multiple tyrosine kinases that blocks the function of the Bcr-Abl protein that signals cancer cells to multiply. Targeted therapy of dasatinib is used to treat most cases of chronic myeloid leukemia and acute lymphoblastic leukemia in patients [3]. AKR1B10 has been recently found to be overexpressed in certain types of cancers, including hepatocellular carcinoma and lung cancer associated with tobacco smoking [4].

Our Combination strategy of the daunorubicin together with dasatinib may, therefore, minimize the adverse effects of each individual drug, enhance the effectiveness of the treatment and allow its prolonged continuity. Dasatinib exhibited a significant inhibitory effect on recombinant AKR1B10, with a half-maximal inhibitory concentration of 0.8 μM. Its inhibition constant Ki was found to be 0.4 μM, and the inhibition data best fitted a mixed-type mode with $\alpha = 1.7$. In conclusion, based on our results, dasatinib may affect the therapeutic efficacy of anthracyclines by preventing anthracycline resistance and reducing their adverse effects.

The study was supported by GAUK (1006218) and by Charles University (SVV 260 416).

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PXFL7

INHIBITION OF HUMAN ALDO KETO REDUCTASE (AKR1C3) BY OLAPARIB – A POSSIBLE REMEDY FOR DAUNORUBICIN RESISTANCE

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The chemotherapeutic application of daunorubicin has significant drawbacks due to drug resistance and related cardiotoxicity. Several members of aldo-keto reductase and short-chain dehydrogenases/reductases superfamilies are responsible for reductive metabolism of parent drug to its less potent metabolite daunorubicinol and belong thus to the most important daunorubicin resistance drivers. Olaparib is a poly (ADP-ribose) polymerase inhibitor used in the treatment of patients with ovarian cancer. In this work, we have aimed to describe possible interactions of olaparib with selected daunorubicin reductases and evaluate their possible utilization for overcoming daunorubicin resistance. Results of incubation experiments with recombinant carbonyl reductases (AKR1C3, AKR1B10, AKR1B1, AKR1A1, and CBR1), showed significant inhibition of AKR1C3, the most active anthracycline reductase. High inhibitory potency (IC_{50} = 5.913 μM) was subsequently confirmed in intact HCT116 cells overexpressing AKR1C3. Using proliferation XTT assay in the same cellular model, we demonstrated the ability of olaparib to reverse enzyme-mediated daunorubicin resistance in a synergistic fashion. Currently, additional experiments focusing on the description of olaparib's effect on expression of *AKR1C3* gene in leukemic KG1α and hepatic HepG2 cells are being conducted. In conclusion, our results present olaparib as a potent AKR1C3 inhibitor able to effectively attenuate daunorubicin resistance at clinically relevant concentrations. Future *in vivo* studies would be helpful to support the rationality of our conclusions and possibly offer new therapeutic option for oncological patients.

The study was supported by InoMed Project: "Pre-application research into innovative medicines and medical technologies" co-funded by the European Union.

PXFL8

NOVEL PHOTODYNAMICALLY ACTIVE HYDROPHILIC AND AMPHIPHILIC ANIONIC (AZA)PHTHALOCYANINE DERIVATIVES FOR TREATMENT OF TUMOROUS DISEASES

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Photodynamic therapy is a clinically approved non-invasive treatment and subject of intense research for the eradication of solid tumors. Phthalocyanines (Pcs) proved to be very promising photosensitizers (PS). Aim of this work is to evaluate the photodynamic activity of newly synthesized anionic water-soluble zinc(II) Pcs with sulfonyl or carboxyl substituents in *in vitro* conditions. Cytotoxicity experiments were performed mainly on human cervix carcinoma cell line HeLa using neutral red uptake assay. Localization of the compounds within the cell, uptake profiles of PSs to the cells and morphological changes after irradiation were also studied. The results of individual experiments have shown high photodynamic activity after irradiation (phototoxicity; EC_{50}) and exceptionally low inherent toxicity (toxicity in the absence of activating light; TC_{50}) of all studied compounds. Phototoxicity was further evaluated on two other human tumor cell lines: MCF-7 (breast carcinoma) and HCT116 (colorectal carcinoma). The most suitable properties were achieved with P44 (EC_{50} = 0.33 μM, TC_{50} > 1000 μM) in the serum-containing medium. For all studied compounds, photodynamic effect resulted in significant morphological changes indicating ongoing cell death. It is worth nothing that photodynamic activity of all studied compounds is negatively affected by the presence of serum (serum-free conditions resulted in up to 95-time increase in photoxicity). Based on obtained results, selected compounds will be included in subsequent studies on 3D spheroid cultures as well as in the *in vivo* evaluation of their photodynamic efficiency on mouse tumor model.

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PXFL9

PRECISION-CUT INTESTINAL SLICES FROM HUMAN TISSUE AS AN *EX VIVO* MODEL FOR ABCB1 TRANSPORTER INDUCTION

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P-glycoprotein (ABCB1), an ATP-binding-cassette efflux transporter, limits intestinal absorption of its substrates and is a common site of drug-drug interactions (DDIs). The drugs causing DDIs on this transporter can act as substrates, inhibitors and/or inductors. Therefore, the absorption of the compounds may be changed and can lead to inappropriate drug plasma levels. Current options for investigating the induction process are limited. For this purpose, we decided to evaluate and optimise human precision-cut intestinal slices (PCIS) to be suitable for long term induction studies. 3 types of media were evaluated: I) Williams' Medium E (WME) as a standard medium used for PCIS, II) two different organoid media (ORG and Vacy) with cooperation of Applied University of Utrecht. Incubations were performed with and without Rifampicin, known inducer of the ABCB1, to validate the model for induction studies

During the evaluation, we collected samples after 24, 48, 72h. ATP/protein measurement was used as a viability marker, RT-PCR and immunohistochemical methods were used to study ABCB1 levels. Rhodamine123 accumulation assay was used as a functional control of ABCB1 expression. In WME after 24h Rifampicin induced the efflux activity of the ABCB1 and increased level of the *ABCB1* mRNA. With increasing incubation time, we saw a similar effect, but also with the increasing deviation. On the other hand, Vacy and ORG medium have a better effect on the ATP/protein level, proliferation and the stability of the activity of ABCB1, but we didn’t observe any effect on the induction with added Rifampicin.

Finally, we could summarize that human PCIS can be used as an *ex vivo* induction model of the ABCB1 in the WME medium. The effect is observed on the activity and mRNA level.

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PXFL10

IN VITRO AND *EX VIVO* EVALUATION OF ANTI-HIV AND ANTI-HCV DRUGS EFFECTS ON DIGOXIN INTESTINAL ABSORPTION

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Efflux transporter P-glycoprotein (ABCB1) is known to limit intestinal absorption of its substrates and represents a site of drug-drug interactions (DDIs). Competition on specific ABCB1 binding sites (for rhodamine123, Hoechst33342, and digoxin) may result in increased drug bioavailability. Using *in vitro* bi-directional transport studies across Caco-2 cells and *ex vivo* method of accumulation in rat- and human-derived precision-cut intestinal slices (PCIS) we showed in previous study that numerous anti-HIV and anti-HCV drugs reveal ability to increase absorption of model ABCB1 substrate, rhodamine123. In this follow-up project, we aimed to investigate the potency of anti-HIV and anti-HCV drugs to decrease intestinal ABCB1-controlled efflux of digoxin and thus to bring direct evidence about the molecular mechanism of interactions between antivirals and digoxin in the intestinal barrier. We found that lopinavir (50 μM), ritonavir (100 μM), atazanavir (50 μM), darunavir (50 μM, 100 μM), daclatasvir (20 μM), grazoprevir (20 μM, 50 μM) and asunaprevir (20 μM, 50 μM) inhibit the efflux of digoxin in Caco-2 cells and human-derived PCIS, while possible interindividual variability was observed in the inhibition of intestinal ABCB1 by rilpivirine (20 μM), abacavir (100 μM), elbasvir (5 μM) and velpatasvir (5 μM). Abacavir (100 μM), dolutegravir (10 μM), elbasvir (5 μM), velpatasvir (5 μM) and sofosbuvir (100 μM) revealed no inhibition of intestinal ABCB1 in Caco-2 cells. In conclusion, we have demonstrated that tested antivirals have potency for DDIs on intestinal ABCB1 with drugs with affinity to digoxin binding site. Our data contribute to explaining the molecular mechanism of reported increased bioavailability of drugs interacting with digoxin binding site when administered together with antivirals.

The study was supported by the Czech Science Foundation (GACR 18-07281Y) and SVV 260 414.

PXFL11

EFFECT OF ANTIDEPRESSANTS ON PLACENTAL HANDLING OF SEROTONIN

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Serotonin (5-HT) is a crucial monoamine for proper fetal development/programming and, therefore, tight regulation of 5-HT homeostasis in the feto-placental unit is required throughout gestation. It is suggested that early in pregnancy the placenta supplies 5-HT to the embryo/fetus. However, at later stages of gestation, the fetus can produce its own 5-HT from maternally-derived tryptophan. Recently, we have discovered a new pathway of placental serotonin handling: placental extraction of excess 5-HT from fetal circulation through organic cation transporter 3 (OCT3). This transporter is known to be inhibited by many endogenous compounds and pharmacological agents including antidepressant drugs. Up to 25% of pregnant woman suffer from depression and approximately 10% are using antidepressants (ADs), typically serotonin-reuptake inhibitors. Safety of this treatment is still discussed, since many adverse effects have been reported. We hypothesize, that ADs can affect serotonin handling in placenta via inhibition of SERT and/or OCT3. This inhibition could lead to accumulation of 5-HT in placental circulation. Experiments were performed using *in situ* dually perfused rat term placenta and *ex vivo* membrane vesicles isolated from human term placenta. Six ADs were tested (paroxetine, citalopram, fluoxetine, fluvoxamine, sertraline, venlafaxine) to affect 5-HT uptake by placenta. We observed significant inhibitory effect by all ADs in both human and rat placenta. We suggest that AD use in pregnancy may affect placental homeostasis of 5-HT and, therefore, placental and/or fetal development.

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PXFL12

EFFECT OF GESTATION AGE ON EXPRESSION AND FUNCTION OF ENZYMES INVOLVED IN TRYPTOPHAN METABOLISM IN HUMAN AND RAT PLACENTA

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Tryptophan (TRP) is an essential amino acid that, besides being utilized for protein synthesis, is a precursor of key physiological biomolecules, such as kynurenine (immunosuppressive), quinolinic acid (neuroactive), serotonin and melatonin. In the placenta, TRP is metabolized via the serotonin (5-HT) and kynurenine (KYN) pathways and the relative flux of substances through these pathways changes depending on the physiological state. We hypothesize that embryo and fetal needs of TRP and its metabolites change over the course of gestation. Therefore, in our study, we investigated gestational age-dependent changes (expression/function) of key enzymes and transporters in tryptophan metabolism by KYN and 5-HT pathways in both human and rat placenta. In detail, we analyzed gene and protein expression of 5-HT transporters (SERT and OCT3) and gene/protein expression and function of TRP metabolizing enzymes (TPH1,2, MAO-A, IDO1,2) in first and third trimester human placenta and in rat placenta of gestation ages 15, 18 and 21. In both human and rat placenta, we detected significant effect of gestation age on expression and/or function of investigated proteins. We suggest these regulatory pathways control levels of TRP and 5-HT in feto-placental unit to ensure proper embryo and fetal development throughout pregnancy.

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PXFL13

THE CONTRIBUTIVE ROLE OF THE PLACENTAL ABCC1 IN MATERNAL AND FETAL PROTECTION. THE CASE OF MARAVIROC

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The protection of the developing fetus against potentially toxic xenobiotics is traditionally discussed in the context of efflux activity of ATP-dependent (ABC) drug transporters, especially ABCB1 and ABCG2, which are located in the apical membrane of the maternal blood facing trophoblast layer. CCR5 antagonist maraviroc shows low cord blood-maternal blood ratio (0.33), indicating limited transfer across placenta. Based on our previous study this could be attributed to the maraviroc substrate affinity toward ABCB1. Nevertheless, only negligible contribution of ABCB1 was recorded in closed-circuit dual perfusion of maraviroc across human placental cotyledon. Surprisingly, we observed decline of maraviroc concentration from circulating perfusates in both, materno-fetal and feto-maternal directions, suggesting retention of maraviroc in placental tissue. Subsequent *in vitro* studies revealed transport of maraviroc with ABCC1 transporter. Localization and function of placental ABCC1 is an object of many discussions, nevertheless, it is obviously placed in basal membrane of trophoblast layer. Besides the trophoblast, we show also high expression of *ABCC1* mRNA in the fetal endothelial cells. Considering placental structure, ABCC1 localization indicates possible transport of its substrates from both maternal and fetal circulations and their accumulation in placental interstitium, which corresponds with the situation observed during perfusion of maraviroc. Since placenta is a temporary organ leaving the body after delivery, we hypothesize ABCC1 might contribute to accumulation of xenobiotics in the placental tissue, as a possible part of a complex strategy ensuring protection of mother and fetus during pregnancy.

This study was supported by SVV 260 414.

PXFL14

PRIMARY HUMAN HEPATOCYTE SPHEROIDS AS *IN VITRO* PLATFORM FOR PRECLINICAL DRUG DEVELOPMENT

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Primary human hepatocytes are considered as a golden standard of *in vitro* models for evaluating hepatic metabolism and toxicity during drug development. However, a culture of primary human hepatocytes is known to lose hepatic phenotype resulting in a significant widespread alteration of metabolic capacity.

Hepatocyte dedifferentiation occurs due to loss of a structural architecture as hepatocytes are disrupted from their organized microenvironment and seeded in a monolayer culture. In this line, the growing effort has been put to develop more relevant *in vitro* models closely mimicking physiological cell environment and phenotype.

Recently, 3D spheroids of primary human hepatocytes have been developed using low adherent plates and well-defined culture conditions. This model showed similar molecular phenotype as that present in adult human liver and maintained hepatocyte functions over the long term.

In my talk, I will focus on the application of 3D hepatocytes in assessing of preclinical pharmacokinetic and toxicological properties of drug candidates.

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PXFL15

CHARACTERIZATION OF TRANSCRIPTOME IN HUMANIZED CAR MICE REGULATETED BY MODEL MURINE LIGAND TCPOBOP

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Nuclear receptor CAR (constitutive androstane receptor; Nr1i3) is a hepatic regulator of xenobiotic and endobiotic metabolism.[1] In mice, CAR activation normalizes glucose and triglyceride serum levels and decreases body weight during high fat diet and nutritional stress.[2] Murine CAR agonist, 1,4-bis[2-(3,5 dichloropyridyloxy)] benzene (TCPOBOP) is connected with hepatomegaly and hepatic proliferation.[3] We studied the effect of TCPOBOP in the wild type mice as well as in mice with humanized CAR, which is not activated by TCPOBOP. We found that TCPOBOP increases liver weights in the both genetic backgrounds independently on CAR activation. Gene expression study shows similar trends on proliferation genes after TCPOBOP treatment, when metabolism is strictly regulated in CAR-dependent manner. Our data shows that TCPOBOP may be a non-specific ligand promoting hepatocyte proliferation independently of human CAR activation.

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PXFL16

DISCOVERY OF POTENT GPBAR1 AGONISTS/FXR ANTAGONISTS

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Bile acid receptors, GPBAR1 and farnesoid X (FXR), emerge as important regulators of glucose, lipid and steroids metabolism in the intestine and liver. Recent animal experiments showed that compounds with combined GPBAR1 agonistic activity in the intestine and FXR antagonistic activity in the liver may be promising candidates for the treatment of glucose metabolic diseases. In the study, we have discovered first-in-class GPBAR1 agonist/FXR antagonists based on testing a set of steroid molecules derived from obeticholic acid (OCA), the prototype FXR agonist. Several derivatives demonstrated potent activation of TGR5, among them compound 2 appeared as highly potent GPBAR1 agonist with EC_{50} being 12 nM in cellular reporter assays. At the same time, compound 2 as well as compound 8 inhibited FXR activation in various FXR reporter gene assays and suppressed OCA- and GW4064-mediated regulation of FXR target genes in differentiated HepaRG cells and primary human hepatocytes. In conclusion, we discovered novel class of dual GPBAR1 agonists/FXR antagonists

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PXFL17

MATHEMATICAL MODELING OF THE SIGNALING PATHWAYS OF NUCLEAR RECEPTORS

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The talk is focusing on the mathematical modeling on the signaling pathways of obeticholic acid activated farnesoid X receptor (FXR). Nuclear receptors like FXR are a family of ligand-regulated transcription factors that are activated by lipid-soluble substances. These substances cross the plasma membrane and interact directly with the nuclear receptors inside the cell.[1] Ordinary differential equations (ODEs) will be used to describe the gene transcription products changes over time. The final model will be used for predictions and extrapolations. FXR does not directly bind to the CY7A1 promoter. Rather, FXR induces expression of small heterodimer partner (SHP), which then functions to inhibit transcription of the CYP7A1 gene.[2] This process is modeled as a continuous function of time: $dR/dt=Kin-(1-(Imax*C^n/(IC50^n+C^n)))-Kout*R$ where drug effect is mediated as inhibition of SHP. Graphical comparison of observations and simulated predictions depicted a good fit of our model to the dataset. Additional mathematical models that describe and link these pathways will be built.

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PXFL18

PROBING THE STRUCTURE AND FUNCTION OF THE CYTOSOLIC DOMAIN OF THE HUMAN ZINC TRANSPORTER ZNT8 WITH NICKEL (II) IONS

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The human zinc transporter ZnT8 is important for assembly of insulin hexamers of β-cells with zinc and for its storage. Its structure and function is modelled on the basis of the 3D structure of the *E.coli* zinc exporter YiiP[1]. However, there are important differences in function as the YiiP protein exports an excess of zinc from cells, whereas ZnT8 exports zinc into subcellular vesicles when there is no apparent excess of zinc. There are two variants, one with tryptophan (W) and the other one with arginine (R) at position 325. These variants have generated considerable interest as the R-variant is associated with a higher risk of developing type 2 diabetes[2]. Since these mutations are at the apex of the C-terminal domain (CTD) towards the cytoplasm, it is not clear how they would affect zinc transport. We expressed the CTD of both variants of human ZnT8 and have begun structural and functional studies. In particular, we found that (i) the metal binding site of the human protein is different from that of *E.coli* protein, (ii) the human protein has a C-terminal extension with three cysteine residues that bind also zinc, (iii) there are small differences in stability between the two variants, and (iiii) nickel ions bind to the cytoplasmic domain of the zinc transporter ZnT8.

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PXFL19

ISOLATED SILYMARIN FLAVONOLIGNANS AND THEIR ABILITY TO INTERACT WITH TRANSITION METALS AND PLATELETS

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Silymarin, a complex of flavonolignans extracted from fruits of *Silybum marianum* (L.) Gaertn., is approved in the EU as a drug. It is also frequently used as a food supplement. Flavonolignans have a polyhydroxylated structure and are poorly absorbed. In addition, if absorbed, they are rapidly conjugated. For this reason, parent flavonolignans rather remain in the gastrointestinal tract while their conjugates are the dominant forms in the systemic circulation. This study was focused on testing 1) the ability of optically pure flavonolignans to interact with transition metals and 2) if their sulfates can block platelet aggregation. Only 2,3-dehydrosilybin (racemate as well as both enantiomers – A and B) has shown moderate ability to chelate iron and copper. Silybin A, silybin B and silychristin were less potent or inactive chelators. Silychristin was found to be the most potent iron and copper reductant. This study also discovered a low potential of sulfates of flavonolignans to block aggregation in whole human blood. Parent flavonolignans were tested for comparison, but their potential was low as well, since it was observed only at concentrations ≥ 120 μM. Mechanistic study showed that their mild activity was likely mediated by antagonism at thromboxane receptors. Although some silymarin flavonolignans blocked recombinant cyclooxygenase 1, their effect on this platelet enzyme in whole human blood was negligible. In conclusion, it is highly improbable that this activity would be manifested *in vivo* due to relatively high concentrations needed to evoke this effect. Contrarily, oral administration of silymarin may influence the kinetics of copper and iron in the GIT.

The study was supported by Charles University (SVV 260 414) and Czech Science Foundation (No. 18-00121S).

PXFL20

PLATELET AGGREGATION IN HEALTHY POPULATION: PRELIMINARY DATA ON AGE-DEPENDENT DIFFERENCES

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Primary haemostasis is a process which contributes to preserving the integrity of the cardiovascular system. It is enabled by platelets, anucleate cells circulating in the bloodstream which aggregate in response to certain stimuli. Altered platelet aggregation can severely affect circulation and lead to many cardiovascular diseases. Dysregulation of this process can result in life-threatening events, such as stroke and acute myocardial infarction, which are the most prevalent causes of mortality in developed countries[1]. An important factor influencing platelet aggregation is the age. There is, however, little data concerning the significance of this factor in experiments using whole blood. Therefore, we have performed a screening of 11 healthy individuals aged 21-58 of both sexes using Multiplate analyzer, which utilizes whole blood and allows examination of various aggregation inducers. A response to several aggregation inducers and standard drugs affecting these inducers were evaluated. We have observed a fairly high interindividual variance with all inducers and used drugs. Preliminary data showed a decrease in response to adenosine diphosphate (ADP) with increasing age. Younger individuals also appeared to be more responsive to acetylsalicylic acid (ASA). Authors are aware that these are initial data and a higher sample size is required to reach more solid conclusion.

The study was supported by PROGRES (170/11/1108-2) and Charles University (SVV 260 414).

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PXFL21

SOLUBLE ENDOGLIN, DOES NOT AFFECT CHOLESTEROL AND BILE ACIDS METABOLISM IN NASH MOUSE MODEL

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Plasma concentrations of soluble endoglin (sEng) are increased in cardiovascular and metabolic diseases associated with hypercholesterolemia, which affect liver functions. Previously, we showed that high sEng plasma levels affect cholesterol and BA homeostasis based on complex liver and intestinal effects. Therefore, the aim of the present study was to investigate effects of high levels of sEng on cholesterol and BA metabolism in liver upon induction of non-alcoholic steatohepatitis (NASH). Three-months-old wild-type and transgenic male mice overexpressing human sEng were fed for 6 months with high fat diet enriched with cholesterol and fructose or chow diet and underwent *in vivo* study with plasma and bile collection. Plasma biochemical analysis, LC/MS of plasma BA and histology were performed. Expression of enzymes and transporters in liver were assessed by qRT-PCR and Western blot. HFD significantly increased body and liver weight, and analysis of liver tissue confirmed NASH by presence of steatosis, fibrosis, oxidative stress, increased activity of ALP and ALT, and hypercholesterolemia in both HFD groups. However, high sEng levels did not significantly modulate development of diet-induced NASH and associated changes in cholesterol and BA metabolism in mice.

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PXFL22

ENDOGLIN MODULATES ADHESION AND TRANSMIGRATION OF MONOCYTES IN OXYSTEROL INDUCED ENDOTHELIAL DYSFUNCTION

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Endoglin (CD105, TGF-βRIII receptor), is essential for proper function of endothelium, but also participate in inflammatory infiltration of monocytes. We hypothesized that endoglin play crucial role in monocyte adhesion and transmigration via endothelial cells when exposed to oxysterol simulating oxidized LDL effects in atherogenesis. HAECs were exposed to 7K (5, 10ug/mL) for 12 hours. Gene expression (endoglin, KLF6, RELA (NF-κB p65), NR1H3 (LXR), ICAM-1) was evaluated using qRT-PCR. Protein levels of endoglin, ICAM-1 and P/E-selectins were evaluated by flow cytometry analysis. Protein levels and localization of RELA, eNOS, p-eNOS was evaluated using confocal fluorescent microscopy. Gene expression and protein levels of endoglin, eNOS, p-eNOS and cell adhesion molecules (ICAM-1, E/P-selectin) as well as transcription genes regulating endoglin expression were significantly increased after premedication with 7K compared to non-treated cells. Inhibition of transcription factors (KLF6, RELA, NR1H3 resulted in inhibition of 7K induced increase of endoglin expression. 7K was able to increase adhesion and transmigration of THP-1 monocytes, trough endothelial cells monolayer. Silencing of endoglin in HAECs inhibited adhesion and transmigration of THP-1 monocytes. In this study, we demonstrated that 7K is able to induce inflammation and increase endoglin expression in endothelial cells via activation of KLF6, RELA and NR1H3 transcription genes. Moreover, we showed that 7K induced adhesion and transmigration of monocytes trough endothelial monolayer depends on the expression of endoglin suggesting that endoglin might play crucial role in cholesterol (oxysterol) induced endothelial dysfunction.

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PXFL23

ENDOGLIN EXPRESSION, SIGNALIZATION AND FUNCTION IN IFLAMMATION INDUCED ENDOTHELIAL DYSFUNCTION

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Endoglin (Eng) expression is linked to regulation of endothelial nitric oxide synthase (eNOS) in endothelial cells resulting in proper function of endothelium. On the other hand, it was proposed that Eng also participates in inflammatory infiltration of leukocytes through endothelium and thus plays negative role in endothelial dysfunction. We aimed to evaluate Eng expression, signalization and function related to endothelial dysfunction induced by proinflammatory tumour necrosis factor alpha (TNF-α) in human aortic endothelial cells (HAECs). HAECs were treated with 10ng/mL TNF-α for 12 h. The mRNA expression of Eng, eNOS, adhesion molecules (ICAM-1, VCAM-1) and transcription factors (KLF6, NF-κB p65 and LXR-α) was measured with qRT-PCR. Protein levels of membrane Eng, ICAM-1, VCAM-1, P/E-selectin and MMP-14 were measured by flow cytometry and soluble endoglin (sEng) levels by ELISA. Transmigration assay was performed using Nunc cell culture inserts. TNF-α treatment decreased mRNA expression and protein levels of Eng and eNOS. The mRNA expression and protein levels of cell adhesion molecules and MMP-14 were significantly increased as well as sEng levels. Interestingly, meanwhile mRNA expression of KLF6 and NF-κB were increased; mRNA expression of LXR-α was decreased. TNF-α induced inflammation led to increased adhesion but not transmigration of monocytes through endothelial cells. We demonstrated that inflammation decreases endoglin expression, increases adhesion but does not affect transmigration of monocytes through aortic endothelial cells. Reduced expression of Eng and increased levels of sEng (that inhibits effects of membrane endoglin) might be responsible for no change in transmigration of monocytes under inflammatory conditions. We propose that Eng participates on the regulation of endothelial dysfunction during inflammation, but to which extent must be further investigated.

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PXFL24

THE TOXICITY OF ALANTOLACTONE AND GERMACRONE TOWARDS DIFFERENTIATED HEPARG CELLS AND THEIR INFLUENCE ON CHOLESTEROL METABOLISM

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Sesquiterpenes alantolactone (ALA) and germacrone (GER) are naturally occuring molecules that are being studied as potential anti-cancer agents. ALA is one of the major sesquiterpene lactone compounds isolated from the roots of *Inula helenium*, *Asteraceae*. GER is a main bioactive constituent found in *Zedoary* oil product, which is extracted from *Curcuma zedoaria* Roscoe, *Zingiberaceae*. Both of these plants have been used in traditional medicine historically. Using the differentiated HepaRG (dHepaRG) cells, a human hepatocyte-like model, we wanted to compare the toxicity towards dHepaRG cells in comparison with results published on highly proliferative cancer cell lines after ALA and GER treatment. Furthermore, a bioinformatic tool BATMAN-TCM [1] was searched for new molecular targets of tested sesquiterpenes. Analysis of their common targets lead us to studying their effects on cholesterol metabolism and 3-Hydroxy-3-Methylglutaryl-CoA Reductase (HMGCR), a major regulatory enzyme in mevalonate pathway. HMGCR protein and mRNA expression were studied at multiple time points, concentrations, as well as single and multiple dose. HMGCR protein expression has shown inhibition after ALA and GER treatment, but mostly at the highest concentrations tested, equal to respective half-maximal inhibitory concentration of cell viability. The mRNA changes were much more variable and time and concentration dependent. The cholesterol level in dHepaRG cells was measured by Amplex Red Cholesterol Assay Kit in a multiple dose experiment in comparison to the model inhibitor lovastatin.

The study was supported by the Czech Science Foundation (Grant No. 18-09946S).

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PXFL25

THE UDP-GLYCOSYLTRANSFERASES IN *HAEMONCHUS CONTORTUS* AND THE METABOLISM OF ANTHELMINTICS

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UDP-glycosyltransferases (UGTs) are important enzymes in the metabolism of xenobiotics and eobiotics. Glycosylation is often the most important conjugation reaction catalyzed by these enzymes in drug metabolism. This reaction results in enhanced elimination of the drug from the organism. Increased expression of UGTs can cause reduction of pharmacotherapy efficiency and development of resistance to drugs. Our model organism is *Haemonchus contortus* a gastrointestinal parasite of small ruminants that have a great ability to develop resistance to anthelmintic drugs. Our previous metabolism study showed that albendazole, ricobendazole and flubendazole underwent several glycosylation steps. Differences of glycosides quantities between resistant and sensitive strains confirmed the connection between anthelmintics metabolism and resistance.[1] In addition, some enzymes from the UGT superfamily, e.g. UGT368B2, are significantly more expressed in adult *H. contortus* of resistant strains than sensitive strains.[2] For functional characterization, the UGT368B2 was expressed in baculovirus-infected insect cells. However, the preliminary results show that UGT368B2 cannot metabolize benzimidazole anthelmintics but steroids. This particular UGT has different role in the organism than biotransformation of xenobiotics (e.g. benzimidazoles). Revealing the features of UGTs from *H. contortus* (e.g. affinity to hexose or to different substrate) could contribute to a more detailed understanding of the reaction's mechanism catalyzed by these enzymes and their role in helminths.

This study was supported by Czech Science Foundation (Grant No. 17-11954Y) and by Charles University (PRIMUS/17/SCI/4).

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PXFL26

PROFILING MICRORNA EXPRESSION IN SUSCEPTIBLE AND RESISTANT STRAINS OF *HAEMONCHUS CONTORTUS* USING SMALL RNA SEQUENCING

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The widespread development of anthelmintic resistance (AR) in *Haemonchus contortus* compromises treatment of helminthosis caused by this economically important parasite of small ruminants. The molecular mechanisms of AR are not fully elucidated. In our study, we focus on microRNAs (miRNAs) which are a class of small non-coding RNAs. MiRNAs play important role in post-transcriptional regulation of gene expression and their dysregulation has been linked to a range of different pathologies. A comprehensive understanding of the functions of miRNAs in AR might help us develop better strategies to the sustainable parasite control. For this reason, we undertook the small RNA sequencing of *H. contortus* isolates with various level of resistance to anthelmintics, namely the susceptible strain, the benzimidazole resistant strain and the multi-drug resistant strain. Differential expression analysis revealed significantly up- or down- regulated miRNAs in adults of resistant strains in comparison to sensitive ones. Since cytochromes P450, UDP-glycosyltransferases and P-glycoproteins were reported to play role in drug resistance[1], we investigated them as the putative targets of differentially expressed miRNAs using RNAhybrid software. Moreover, from the sequencing data, 207 sequences were defined as potential novel miRNAs using miRDeep2 program.

The study was supported by Charles University (PRIMUS/17/SCI/4).

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PXFL27

METABOLIC PATHWAYS OF NEW POTENTIAL ANTHELMINTICS IN *HAEMONCHUS CONTORTUS* AND ITS HOST

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Haemonchus contortus is one of the most important parasitic nematodes of small ruminants with worldwide distribution causing significant loses to many farmers. Anthelmintic drugs still represent the main strategy to control burdens of *H. contortus*. Unfortunately, wide spread resistance to available anthelmintics makes treatment difficult. Therefore, there is a global need for new and effective anthelmintic drugs. Two newly synthetized compounds HBK4 and BLK127, and already registered antipsychotic drug sertraline are promising candidates of new anthelmintics. It is known, that drug resistance is associated with accelerated drug metabolism and for this reason we would like to compare biotransformation of HBK4, BLK127 and sertraline in drug-resistant and drug-sensitive strains of *H. contortus.* In addition, we will also monitor biotransformation and hepatotoxicity of these compounds in ovine liver.

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PXFL28

CIRCULATION OF ANTHELMINTICS IN THE ENVIRONMENT

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Several ways can cause drug resistance in sheep breeding. Our project monitors the intake of a residual amount of the albendazole (ABZ) and its transformation products (TPs) during grazing of sheep.

Our preceding studies showed the ability of plants to uptake and metabolize anthelmintics such as benzimidazole, macrocyclic lactones, and amino-acetonitrile derivatives in six plant species. Plant derivated metabolites can be considered as deactivation products but some of them are even more anthelmintically effective than the parent compound. Moreover, a lot of anthelmintics metabolites (especially glycosides) can be converted back to parent compound through enzymatic or acidic hydrolysis in the gastrointestinal tract of grazing animals. In the case of infected animals, nematodes thus might be exposed to very low doses of anthelmintics and this phenomenon could help to increases the anthelmintic resistance.

This project simulates such a situation and monitors the occurrence of residues of ABZ and TPs in biological samples collected from ten domestic sheep (*Ovis aries*). In the pilot study naive sheep (e.g. without nematodes) were used. Two species of meadow plants *Medicago sativa* and *Trifolium pratense*, common plants on pastures, were chosen. An experimental field area with these plants was fertilized by excrements from ABZ treated sheep (different flock of sheep) in spring 2019.

ABZ and TPs have been found in the fertilized plants and in related soil too, after two months from fertilization. Furthermore, these plants were administered to the sheep for ten days and during that time samples of abomasum contents, faeces, and plasma were collected in different time intervals. ABZ and the main TPs, ABZ-sulfone, and ABZ-sulfoxide, were detected in all samples. UHPLC-MS/MS was used for qualitative and quantitative analyses.

The study was supported by the Czech Science Foundation, grant No. 18-07724S, by the Charles University (projects SVV260416/260412)

PXFL29

EFFECT OF ANTHELMINTIC RESIDUES ON TRANSCRIPTION LEVEL OF BIOTRANSFORMATION ENZYMES

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Anthelmintics, the only effective treatment of devastating infection diseases of animals caused by parasitic helminths, have been widely and heavily distributed all over the world. In the agriculture industry the most used classes of anthelmintics are benzimidazoles, macrocyclic lactones, imidazothiazoles and amino-acetonitrile derivatives. Parasitic helminths, specially nematodes, have developed resistance to all of them. In front of all parasites stands *Haemonchus contortus*, as the quickest nematode in resistance development. This hematophagous parasite living in sheep abomasum causing enormous losses in animals' production is well studied for mechanisms of resistance development. *H. contortus* prosper with very effective detoxification system via biotransformation enzymes and can relatively quickly react to constant usage of anthelmintic drugs. In our current studies we observed that even very low – sublethal concentrations of anthelmintics, that may be preserved in environment, can cause up and down regulation of biotransformation enzymes on transcription levels. Furthermore, the analysis of albendazole metabolites showed enhanced biotransformation after preincubation in sublethal concentrations of albendazole.

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PXFL30

PRELIMINARY RESULTS OF ANTI-INFLAMMATORY ACTIVITY IN SELECTED FERN SPECIES

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Ferns are a potential source of bioactive phytochemicals and based on our previous research, we tested selected species for the anti-inflammatory activity. The crude methanol extracts were screened at a concentration of 10 µg·mL-1 for inhibitory activity against pro-inflammatory enzymes cyclooxygenases (COX-1 and COX-2) and 5-lipoxygenase (5-LOX). The COX-1 inhibitors are reported as effective in the prevention of neuroinflammatory or cardiovascular diseases1, and several tumours2. COX-2 is considered as a key pro-inflammatory enzyme, over-expressed in most sites of inflammation and responsible for the characteristic inflammatory symptoms (redness, pain, edema, fever and loss of functions)2. 5-LOX inhibitors are reported to play a role in the prevention of tumours, allergic disorders and asthma2. Our results revealed that the most fern species have potential in selective COX-1 inhibitory activity. Significant inhibition to COX-1 was measured in *Dryopteris cambrensis* (92,46%) or *Athyrium distentifolium* (91,18%). Only a few fern species revealed moderate inhibition to COX-2 (*Dryopteris expansa* and *Dryopteris aemula*). Significant 5-LOX inhibitory activity was measured in *Onoclea sensibilis* (71,06%) and *Dryopteris caucasica* (68,32%). Our results reveal several European ferns, as a potential source of anti-inflammatory compounds.

The study was supported by the Charles University, SVV 260416.

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PXFL31

DETERMINATION OF TOXICITY OF BRAF INHIBITORS *IN VITRO*

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Malignant melanoma belongs between one of the most serious skin diseases nowadays. However, treatment of advanced melanoma is difficult and ineffective. A significant part of melanomas exhibits a mutation of the gen for oncogenic BRAF kinase, which is responsible for stimulation of proliferation and surviving of cancer cells. These melanomas can be treated using novel therapeutic approach encompassing specific BRAF inhibitors, dabrafenib or vemurafenib (1). Available clinical studies indicate that the toxic effect of the BRAF inhibitors is focused primarily on podocytes localized in the glomerular membrane. Our study is focused on evaluation of cytotoxic effect of BRAF inhibitors on selected model renal cells in vitro to confirm the renal target of toxicity. Main aim was to analyze whether renal toxic effect of BRAF inhibitors is specifically limited only to the podocytes or other renal cells may be damaged. The experiments were performed using human cell lines representing different types of kidney cells (HEK-293, PODO/TERT256, HK-2) and standard liver cell line HepG2 as a comparator. Amphotericin B and paracetamol were employed as comparative toxins. The IC_{50} values determined by analysis of inhibition curves were used for comparison. The found experimental data showed comparable toxic effect of the tested BRAF inhibitors in each used kidney cell line. However, vemurafenib exhibited significantly higher toxicity compared to dabrafenib. The in vitro toxicity of vemurafenib in all renal cell lines was even stronger than that of known renal toxin amphotericin B. The results may suggest that the toxic damage of kidney caused by BRAF inhibitors treatment encompass not only podocytes but also other kinds of kidney cells including renal tubular cells may be involved.

The study was supported by grants of Charles University Progres Q42 - The Dean's Fund.

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PXFL32

THE EFFECTS OF THE CIGARETTE SMOKE ON HUMAN SKIN AND POSSIBILITIES OF ITS PROTECTION

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Cigarette smoke (CS) represents a significant source of air pollution with negative effects on human health. CS is strongly associated with the number of pulmonary and cardiovascular diseases, but it also induces significant damage of the skin which is often neglected. In the skin, one of the negative impacts of the long-term exposure to CS is the skin barrier impairment, premature skin aging and development of skin diseases such as atopic dermatitis, psoriasis, acne, even skin cancer.

In this study we investigated the effect of CS on the skin using porcine cadaver auricular skin explants that are very similar to human skin. After application of the CS on the surface of the skin samples, we observed significant negative changes in both the epidermis and dermis such as the presence of large amount of reactive oxygen species (ROS), oxidation of proteins and lipids, DNA damage, inhibition of collagen gene expression, upregulation of matrix metalloproteinase 1 and filaggrin and overall decrease in the skin cell viability.

Furthermore, this model was used to evaluate the ability of the selected compounds commonly used in cosmetics and dermatology with various mechanisms of action to prevent CS-induced skin damage. We tested several polysaccharides and their derivatives such as sodium hyaluronate (HA) of various molecular weight (MW: 1,7 MDa, 500 kDa, 15 kDa, 5 kDa), carboxymethyl-glucan, schizophyllan, glucomannan; then sodium ascorbyl phosphate (vitamin C), niacinamide (vitamin B3) and D-panthenol (provitamin B5). After incubation of the skin explants with the tested compounds and subsequent exposure to CS, the level of ROS and peroxidation of the skin barrier lipids together with gene expression of the proinflammatory cytokine IL-6 were determined. All the tested substances significantly protected the skin against CS from which the most effective was vitamin C due to its strong antioxidant properties and 1,7 MDa HA with its ability to create a protective film on the skin surface. The film-forming properties of HA were MW-dependent and correlated with its protective effect which both decreased with lower MW.

The results show that the exposure of the skin to CS leads to the significant skin damage which can be effectively prevented using some conventional cosmetic and dermatological ingredients with various mechanisms of action.

In the second part of our research we investigated the differences between the epidermis of smokers and non-smokers. For this experiment we used samples of the epidermis obtained by suction-blister technique from volar forearm of smoking (history of smoking min 15 years, min 15 cigarettes/day) and non-smoking women. We performed cDNA microarray analysis for the determination of the gene expression profile of the epidermis of

smokers and non-smokers. Significant differences were observed in the expression level of the number of genes with various functions. In the epidermis of smokers, we found significant upregulation of genes involved in the epidermal differentiation complex which was also confirmed using qRT-PCR and on the protein level.

The study was supported by the Charles University, project GA UK No. 332119.

Lecture hall A

Session 7 - Pharmacognosy and Toxicology of Natural Compounds: ***8:15 – 14:45***

Chairpersons: Assoc. Prof. Lucie Cahlíková and Assoc. Prof. Karel Šmejkal

FG1

ANALYSIS OF COPPER-CHELATING ACTIVITY OF ISORHAMNETIN AND TAMARIXETIN

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Isorhamnetin and tamarixetin are the main *O*-methylated metabolites of the flavonoid quercetin. Flavonoids represent a large group of polyphenolic compounds which belong to plant secondary metabolites and have been suggested to have a positive impact on human health. They are a common component of the human diet. Chelation of transient metal ions is one of their proposed mechanisms of action. Copper is an essential trace element necessary for many physiological processes. However, free copper ions can cause damage to various biomolecules and lead to tissue impairment.[1] Disorder of copper homeostasis can be treated with copper chelators. Due to the limited array of the currently used copper chelators, research of such compounds continues to be of clinical interest.[2] In this *in vitro* study, tamarixetin and isorhamnetin were tested for their interactions with copper at four (patho)physiologically relevant pH conditions ranging from 4.5 to 7.5 by competitive and non-competitive methods. Competitive studies showed that both compounds were active copper chelators and non-competitive studies showed that the preferred stoichiometries were mainly 3:2 and 2:1 (flavonoid:metal). Analysis of cupric ion reduction has also been performed. In conclusion, both compounds showed good ability to chelate and reduce copper ions.

The study was supported by Charles University (1080217 C).

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FG2

SCREENING OF ANTIPLATELET ACTIVITY OF ISOQUINOLINE ALKALOIDS

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Alkaloids are nitrogen containing secondary metabolites mostly found in plants and other organisms. They have been used for the treatment of many ailments such as cancer, malaria, diabetics, cardiovascular diseases (CVDs).[1] Platelet cells perform a significant role in haemostasis and uncontrolled regulation of platelets can lead to CVDs progression. However, antiplatelet therapy has its limits, and so current research seeks to find active substances with different mechanisms of action. In this study, we have measured antiplatelet aggregation activity of selected 14 isoquinoline alkaloids isolated from plants. Multiple Electrode Aggregometry has been used where multiple measurement is possible in one time. The screening was performed with the use of whole human blood. Arachidonic acid was used as aggregation inducer and acetylsalicylic acid (ASA) as a standard drug. Percentage of aggregation has been measured from correlation of base line and linear portion of the aggregation curve. The most active compounds were papaverine, scoulerine and bulbocapnine. The first two substances exhibited similar inhibitory activity as ASA at the concentration of 40μM while were significantly less active at lower concentrations. Initial screening revealed the most active substances that would need a series of experiments to determine the mechanism of their action. The compounds have already been tested for antagonism at thromboxane receptors using the stable thromboxane analogue U46619.

The study was supported by Charles University (SVV 260 412).

Reference:

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FG3

PHYTOCHEMICAL ANALYSIS AND BIOLOGICAL ACTIVITY OF *AZORELLA COMPACTA*

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Azorella compacta Phil. (syn. yareta, Apiaceae) is a compact evergreen cushion shrub growing at altitudes between 3000 and 5000 metres in the South American Andes. The plant is frequently used in traditional medicine in the form of infusions and decoctions to treat various diseases (cold, pain, asthma, diabetes etc.) and relieve altitude sickness.[1] The major secondary metabolites that have been described in azorella plant are diterpenoids. A few of the potential medical effects were observed, such as antihyperglycemic effect and *in vivo* inhibition of *Plasmodium berghei* growth in mice;[2] an antimicrobial activity and an anti-*Trypanosoma cruzi* activity were further confirmed.[3] Polyphenols are other metabolites found in the azorella plant. Previous experiments with aqueous extracts proved their antioxidant and immunomodulatory activity; however, it is not known which particular substances are responsible for the effects. The main aim of the study is to prove selected biological activities of aqueous and ethanolic extracts of the whole plant *Azorella compacta*. Isolation and finding the specific substances responsible for biological effect is another goal of the study. Due to the current problems of widespread diseases and the lack or insufficient clarification of some findings on the effects of azorella plant, anti-aggregation, antityrosinase, antiallergic and antiparasitic activities were selected for testing.

On account of the early stage of research, this study does not provide any valid data yet. The presentation will be focused on the introduction of the plant and planed methods.

The study is supported by Research Founding SVV 260 416 of Charles University.

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FG4

CYTOTOXIC EVALUATION OF ASTAXANTHIN MONOESTERS FROM MICROALGAE *HAEMATOCOCCUS PLUVIALIS*

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Reddish ketocarotenoid astaxanthin (AXT) has more powerful antioxidant capacity than *β*-carotene, vitamin E, zeaxanthin, lutein or canthaxanthin.[1] The ability of this compound to cope with various diseases, thus to protect human body, has been also examined. Nowadays, this pigment attracts more and more interest from various industries, such as nutraceutical and cosmetic due to its different bio-functional properties that can have a huge impact on human health or its nutrition. The major natural source of AXT is the freshwater microalgae *Haematococcus pluvialis*, in which this compound is being present mainly in the esterified form. AXT is esterified with different fatty acids that are well-known for having various biological properties. It is believed that they may bestow these properties to AXT esters. From *H. pluvialis* biomass, five AXT monoesters have been isolated in our laboratory by high performance countercurrent chromatography (HPCCC) and their identity was confirmed using the high-performance liquid chromatography–atmospheric pressure chemical ionization–high resolution tandem mass spectrometry (HPLC–APCI–HRMS/MS). The fraction of astaxanthin monoesters showed a cytotoxic activity against the human gastric cancer cells (AGS cell line) using the MTT (3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide) reduction assay. Later, the cytotoxic effect of AXT esterified with linolenic acid (**1**), linoleic acid (**2**), palmitic acid (**3**), oleic acid (**4**) and stearic acid (**5**) has been examined over these cells, showing that only the compound **4** exhibits a cytotoxic activity against this cell line.

The study was supported by SVV 260294 and Charles University Grant's Agency (GAUK 1134217).

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FG5

ISOLATION OF ALKALOIDS FROM *VINCA MINOR* L. AND THEIR INHIBITORY ACTIVITY ON HUMAN CHOLINESTERASES

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Vinca minor L. (*Apocynaceae*) is an evergreen trailing subshrub common in western and southern Europe, mostly as a groundcover in temperate gardens. It contains over 50 indole alkaloids. It has been discovered that the alkaloidal extract from overground parts exhibits selective inhibitory activity against human butyrylcholinesterase (BuChE) (IC_{50} 13,60 ± 0,83 μg/ml), contrary to acetylcholinesterase (AChE) (IC_{50} 191,58 ± 38,03 μg/ml). BuChE is responsible for cleavage of acetylcholine, especially at the advanced stage of Alzheimer‘s disease, and also for its aggregation of β-amyloid that increases its neurotoxicity. Thus, BuChE represents an interesting target for new drug development, and alkaloids from *V. minor* seems to be a promising source of the effective structures. Seven alkaloids have been isolated from the original fraction no. 147–214, which had been obtained from the alkaloidal extract using column chromatography with aluminium oxide. The alkaloids have been separated by TLC techniques on silica-gel, and identification of their structures was determined by HPLC/DAD/MS-ESI, GC/MS-EI, and NMR instruments. Four of these alkaloids have been isolated for the first time from *V. minor* ((+)-aspidofractinine, (+)-raucubaine, (-)-demethoxycarbonyltetrahydrosecodine, (-)-demethoxyalstonamide), whereas (-)-minovincine, minoriceine, and strictamine had already been isolated in previous research. All of the isolated alkaloids have been tested on the inhibitory activity of human AChE and BuChE. The most active alkaloids against BuChE were (-)-demethoxycarbonyltetrahydrosecodine (IC_{50} 0,65 ± 0,17 μM) and (-)-demethoxyalstonamide (IC_{50} 56,38 ± 2,58 μM). Other isolated alkaloids did not show a substantial effect on the inhibition of BuChE. None of the alkaloids exhibited significant activity against AChE.

The study was supported by projects SVV 260 412 and PROGRES Q42.

NMR ELUCIDATION OF ACETYLCARANINE

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The presented alkaloid was isolated from *Nerine bowdenii* (Amarylidaceae) at the Department of Pharmaceutical Botany. The Amarylidaceae family is very rich in alkaloids containing isoquinoline scaffold.

The isolated substance was characterized by ^{1}H and ^{13}C NMR experiments as well as Heteronuclear Single Quantum Correlation (HSQC), Heteronuclear Multiple Bond Correlation (HMBC) and Correlation Spectroscopy (COSY) experiments. Other spectroscopic methods such as HRMS and optical rotation were also used.

The determination of this structure will be discussed.

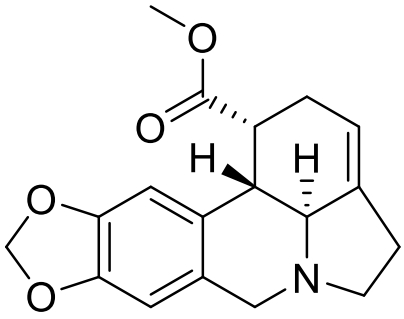

Figure 4 The identified structure of acetylcaranine [1]

The study was supported by Czech Science Foundation (project GA ČR 18-17868S) and Charles University (project SVV 260 401).

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FG7

BROUSSONETIA PAPYRIFERA AS A RICH SOURCE OF VARIOUS SECONDARY METABOLITES

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Broussonetia papyrifera (L.) L'Hér. ex Vent. (Moraceae), known as paper mulberry, is a deciduous tree naturally occurring in Southeast Asia. This plant is used in traditional Chinese medicine for various medicinal purposes. Extracts of *B. papyrifera* exhibit antioxidant, anti-inflammatory, antidiabetic and antimicrobial properties[1]. Several isolated compounds have huge potential to be used in medicine as they exert significant biological activities.

In the present work, chromatographic separation of chloroform part of ethanolic extract of the branches and twigs of *B. papyrifera* led to the isolation of 29 compounds belonging to the group of flavonoids, coumarins, lignans, stilbenoids, and fatty acid derivatives. The structures of the substances were determined by HRMS, and by 1D and 2D NMR. Broussofluorenone C (**23**) and (*R*)-8-methoxymarmesin (**11**) have been introduced as new compounds and further compounds (**1, 3, 6, 9, 10, 12, 19, 20, 28, 29)** have been isolated from *B. papyrifera* for the first time. The effect on insulin signaling cascade and NF-κB inhibitory activity of selected phenolic substances have been evaluated in *in vitro* assays.

The study was supported by grant IGA VFU Brno 303/2019/FaF.

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FG8

ISOLATION AND IDENTIFICATION OF ACTIVE CONSTITUENTS FROM *PAULOWNIA TOMENTOSA* STEUD. FRUIT

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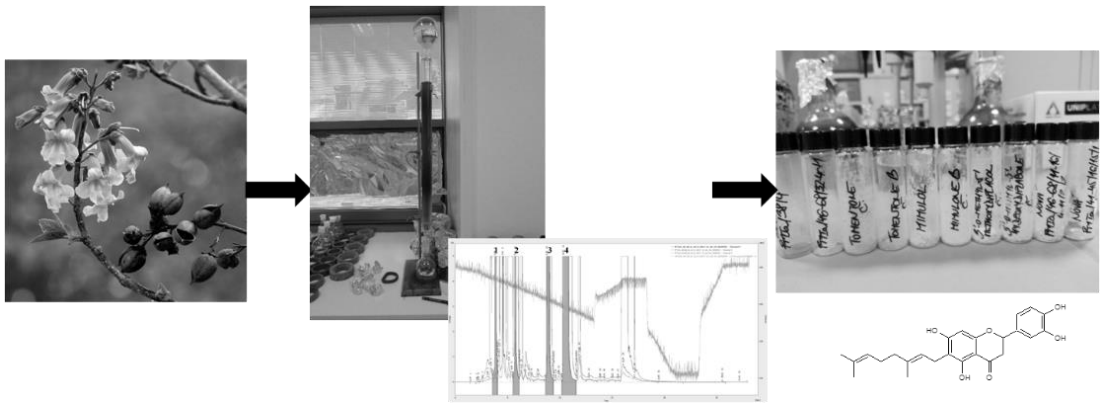
Paulownia tomentosa Steud. (Paulowniaceae), a traditional Chinese medicine plant, is a rich source of multifarious secondary metabolites, mainly of phenolic character. Flavonoids, lignans, phenolic glycosides, phenolic acids, terpenoids, quinones, glycerides, and miscellaneous other compounds have been isolated from different parts of this plant. Recent interest in *P. tomentosa* has focused on isolation and identification of prenylated or geranylated flavonoids, which exhibit interesting biological activities, such as antioxidant, antimicrobial, anti-inflammatory, cytotoxic, and others[1]. More than sixty compounds with a prenyl or a geranyl side chain attached to the flavonoid skeleton at position C-6 have been isolated from leaves, flowers, and fruit of *P. tomentosa* till today.

Chromatographic separation of fractions obtained from *P. tomentosa* fruit led to the isolation of 14 flavonoid derivatives. The structures were determined by evaluation of the UV, MS, and NMR data. Eight of these compounds were isolated from a natural source for the first time.



The study was supported by IGA VFU Brno 311/2019/FaF and IMA VFU Brno 2019-FaF-04.

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FG9

IDENTIFICATION OF PLANT PHENOLICS AS NOVEL PPARγ AGONISTS

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Peroxisome proliferator-activated receptor-γ (PPARγ) is a nuclear receptor protein playing an essential role in lipid and glucose homeostasis. It is recognized as the receptor of the thiazolidinediones—a class of drugs used to manage hyperglycaemia.[1]

Aim of this project was to determine PPARγ agonist activity of plant phenolics isolated from *Paulownia tomentosa* (Thunb.) Steud., Paulowniaceae and *Morus alba* L., Moraceae. Potential agonists among the compounds isolated at Dpt. of Natural Drugs were preselected using virtual screening based on binding to PPARγ (AutoDock Vina; PDB ID: 1FM6). Only the compounds binding to binding site with satisfactory binding affinity were chosen.

The selected compounds were then tested for agonist activity using PPARγ luciferase reporter gene transactivation assay. HEK293 cell culture was transiently transfected with PPARγ expression plasmid, reporter plasmid (tk-PPREx3-luc), and pEGFP-N1 as internal control.

After 18h of incubation luminescence and fluorescence was measured and expressed as ratio. The two most active compounds were geranylated flavanones from *P. tomentosa*: diplacone and mimulone. Both compounds exhibited dose-dependent activation of PPARγ with its peak at 3 μM: 2.6-fold and 3.6-fold, resp. ($p \leq 0.0001$). Whereas rosiglitazone (positive control) showed 7.4-fold activation. Both compounds therefore have an antidiabetic potential.

The research stay in Vienna was supported by AKTION semester scholarship. Special thanks to prof. V. Dirsch and her research group for hosting me.

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FG10

ISOLATION AND IDENTIFICATION OF *SCELETIUM TORTUOSUM* CONSTITUENTS

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Sceletium tortuosum (L.) N.E.Br. (Aizoaceae), also known as kanna, is a succulent plant from South Africa. It is known to contain several types of alkaloids, from these the mesembrine alkaloids are the most abundant. Structure of the mesembrine alkaloids is based on 3a-aryl-*cis*-octahydroindole ring. Main alkaloids from this group are mesembrine, mesembrenol, mesembrenon, mesembranole. Studies of biological activities have shown that mesembrine alkaloids act primarily as monoamine releasing agents and secondarily as serotonine reuptake inhibitors. These compounds have also displayed inhibitory activity on phosphodiesterase 4[1,2].

In this work we present isolation of eight compounds from *S. tortuosum* plant. Dried plant collected in South Africa was extracted with methanol. The methanolic extract was subjected to liquid-liquid extraction with hexane and chloroform. Hexane and chloroform extracts were separated by several column chromatographies. We used semi-preparative HPLC with UV and ELSD detection for isolation of pure compounds. Five compounds were isolated from the hexane part of methanolic extract and three from the chloroform part.

The study was supported by IGA VFU Brno 320/2016/FaF, IGA VFU Brno 307/2017/FaF and IMA VFU Brno 2019-FaF-02.

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FG11

ANTIMICROBIAL PROPERTIES OF CANNABINOIDS FROM CANNABIS INDICA

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Tested compounds were isolated from C. indica with the use of chromatographic methods (column chromatography, analytical TLC, analytical and semi-preparative HPLC). Six compounds obtained in the pure form were identified as major cannabinoids (CBG, CBGA, THCA, δ9-THC,CBDA, CBN). These compounds, plus the standard of CBD, were then used for the research of their antimicrobial properties against gram-positive and gram-negative bacteria. Firstly, minimum inhibition concentrations were measured. As an example of gram-positive bacteria we chose Staphylococcus epidermidis, because of its ability to form biofilm. Activity of the subinhibition concentrations of cannabinoids against biofilm formation was also the subject of this research. Mutant strain of Chromobacterium violaceum was selected as an example of gram-negative bacteria. We also used this strain to study the effect of the subinhibition concentrations of the cannabinoids against the quorum sensing, the type of cell-cell communication, which plays the key role in the regulation of bacterial behavior. As a result of this research, we observed strong bacteriostatic activity of the cannabinoids (excluding CBGA) against gram-positive bacteria, but almost no effect on gram-negative bacteria, which is in line with the previous experiments.1 Specific anti-biofilm activity was observed for the CBGA. Quorum-quenching activity will be the subject of further research.

The study was supported by the grant 310/2019/FaF from IGA VFU Brno

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FG12

ISOLATION OF AMARYLLIDACEA ALKALOIDS FROM *HIPPEASTRUM* CULTIVAR FERRARI AND EVALUATION FOR THEIR BIOLOGICAL ACTIVITIES

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Hippeastrum is a well-known ornamental Amaryllidaceae genus native to South America and comprises approximately 60 species, about 30 of which are found in Brazil; the majority are endemic and poorly studied.[1] This genus has been traditionally used to cure piles, tumors and various inflammatory disorders such as asthma. Physiological activities reported for plants of this genus include psychopharmacological, against *Trichomonas vaginalis* and cytotoxicity.[2]

The summary ethanolic extract was prepared from fresh bulbs of *Hippeastrum cv.* ferrari and separated on column chromatography. More than three hundred fractions were collected and pooled together based on TLC into fifteen subfractions. So far, fourteen alkaloids in pure form have been isolated belonging to different structural types. The isolated compounds were identified by comparison of obtained analytical data (MS, NMR, optical rotatory) with the literature data. All isolated alkalois were assayed for their biological activities- e.g. inhibition of HuAChE and HuBuChE, POP (prolyloligopeptides), GSK-3β (glycogen synthase kinase-3β), anticancer potential (cytotoxicity against panel of cancerous and noncancerous cell lines) and others. Within isolated alkaloids montanine displayed strong cytotoxicity against all tested cancer cell with IC_{50} values between 1.04 – 1.99 μM.

The study was supported by SVV 260 412 project.

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FG13

ALIPHATIC AND AROMATIC DERIVATIVES OF MONTANINE-TYPE ALKALOIDS AND THEIR CYTOTOXIC ACTIVITY

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The Amaryllidaceae plant family are known as a fruitful source of particular alkaloids which possess different range of bioactivities, pointedly antitumor, antimalarial, antibacterial and cytotoxic activity. Among these compounds, montanine-type alkaloids are characterized by 5,11-methanomorphanthridine ring system and known for their potential cytotoxic activity. Montaine and coccinine isolated from *Haemanthus humilis* Jacq., are showed to have in vitro IC_{50} value between 1.9 and 23.3 μM against 6 different cancerous cell lines.[1] In another study manthine and 3-*O*-methylpancracine were synthesized through rearrangement of haemantamine and showed GI_{50} values between 3 to 31 μM on 6 cancerous cell lines.[2] These evidences introduce montanine-type structure as a potential cytotoxic framework to be investigated.

This project is focused on different chemical group replacement on montanine type alkaloids framework in order to improve the cytotoxic activity and also to figure out the possible SAR of these compounds. Since these alkaloids are rare in natural sources, based on previous publications, they were synthesized using haemantamine intermolecular nucleophilic rearrangement, [2] and various chemical group were tried in position 3. In this presentation we will report the procedure of preparation of about 20 aliphatic and aromatic esters and ethers and results from their cytotoxic activity.

The study was supported by SVV 260412 project.

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FG14

DERIVATIVES OF AMARYLLIDACEAE ALKALOID AMBELLINE AS POTENTIAL DRUGS

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Twenty-one derivatives of crinane-type alkaloid ambelline were developed. All of them were inspected for their potential inhibitory activity of acetylcholinesterase (AChE) and butyrylcholinesterase (BuChE). Esters of ambelline seem to be promising selective inhibitors of BuChE, which plays significant role in later stages of AD when levels of BuChE rapidly increase. The benefits of BuChE inhibition are predicted based on its symptomatic-relief mode of action, but also on suggestion an involvement of this enzyme in regulating disease progression. Seven aromatic derivatives with different substitutions on the attached aromatic ring were endowed with remarkable inhibitory potency against *h*BuChE (IC_{50} < 5 μM), highlighting three top-ranked compounds as follows: 11-*O*-(1-naphtoyl)ambelline, 11-*O*-(2-methybenzoyl)ambelline, and 11-*O*-(2-methoxybenzoyl)ambelline with IC_{50} values of 0.10 ± 0.01 μM, 0.28 ± 0.02 μM, and 0.43 ± 0.04 μM. Notably, four derivatives displayed selective *h*BuChE inhibition profile with selectivity index higher 100. *In vitro* investigation was supported by computational studies predicting compound's plausible binding modes in the active sites of *h*BuChE. To predict CNS availability logBB was calculated and the data correlated well with those obtained from PAMPA assay. Based on the obtained data all compounds should be able to permeate blood-brain barrier.

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FG15

ALKALOIDS AS POTENTIAL DRUGS IN THE TREATMENT OF ALZHEIMER'S DISEASE

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Alkaloids are a very important group of secondary metabolites with a number of interesting biological effects (anticancer, analgesic, anticholinesterase, antimalarial, …). Among the best known and most important substances are for example Ergot alkaloids used in therapy diseases of the circulatory system, Vinca alkaloids such as vincristine and vinblastine with anticancer activity or Amaryllidaceae alkaloid galanthamine which is used in therapy of Alzheimer´s diseases (AD).[1]

AD is one of the most frequent causes of dementia in the world. AD consisting of many cognitive and neuropsychiatric manifestations as is damage of memory, speech, orientation and others. During AD in the brain occurs to pathological changes of some enzyme systems that result in loss of neurotransmitter acetylcholine (Ach) and formation of amyloids plaques and neurofibrillary tangles (NFTs). NFTs consisting of paired helical filaments, with the main component being hyperphosphorylated τ-protein. Phosphorylation of τ-proteins is primarily dependent on glycogen synthase kinase-3β (GSK-3β) and cyclin-dependent kinase 5.[2] Alkaloids of different structural types have been screened for their potency to inhibit GSK-3β at a concentration 50 μM. Promising results have been demonstrated by two alkaloids 5/205 from *Vinca minor* (IC_{50} = 4.08 ± 0.14 μM) and GV 8-3b from *Geissospermum Vellosii* Alemao (IC_{50} = 7.18 ± 1.12 μM).

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FG16

ALKALOIDS OF THE AMARYLLIDACEAE FAMILY AS POTENTIAL DRUGS IN THERAPY OF DISEASES OF AFFLUENCE

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51 % of all drugs and 65 % of small-molecule drugs approved between 1981 – 2014 are in certain connection with natural compounds[1]. This proves that natural compounds and their derivatives are still an important source where new potential drugs can be sought. One of interesting groups of bioactive compounds are alkaloids. Amaryllidaceae family belongs among the twenty most important alkaloidal families with almost 600 of various Amaryllidaceae alkaloids isolated and structurally described so far.

34.3 kg of fresh bulbs of *Narcissus* cv. Professor Einstein were processed to obtain 31.7 g of summary alkaloidal extract. This extract was subjected to separation by different chromatographic methods. At the end, twenty-five alkaloids were isolated and identified by GC-MS, ESI-MS, NMR, X-ray, optical rotation and literature. One compound was identified as a new unpublished alkaloid of lycorine structure type - 7-oxonorpluviine. All compounds isolated in sufficient amount have undergone series of bioassays associated with Alzheimer‘s disease, cytotoxicity and activity against the liver stage malaria *in vitro*. The most promising is cytotoxic activity of pancracine – hence it went through study of the cell cycle and apoptosis induction interference.

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FG17

SEMISYNTHETIC DERIVATIVES OF AMARYLLIDACEAE ALKALOID HAEMANTHAMINE AS POTENTIAL DRUGS IN THE TREATMENT OF ALZHEIMER'S DISEASE

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Plants of the Amaryllidaceae family contain approximately 85 genera and 1100 species, have a wide distribution through both tropical and sub-tropical regions worldwide. Alzheimer's disease (AD) is the most prevalent neurodegenerative disease worldwide with complex etiology and multifaceted pathophysiology and data indicate an exponential rise in the number of cases of this disease. The well-known Amaryllidaceae alkaloid (AA) galanthamine is marketed drug for AD therapy under the commercial name Reminyl© (galanthamine hydrobromide).[1]

Studies also pointed out various pharmacological properties of semisynthetic derivatives of some Amaryllidaceae alkaloids. One of the most interesting AA alkaloids is alkaloid haemanthamine (HMT), which is widely distributed through Amaryllidaceae plants. Based on our previous results, where we reported promising anti-cholinesterase activity of pilot series of HMT derivatives, we decided to continue in preparation of further semisynthetic derivatives. [1,2]

Several new aromatic and aliphatic esters and pilot ethers have been synthesized for structure-activity relationship (SAR). New compounds were identified by 1D and 2D NMR, GC/MS and ESI-MS methods. All newly developed compounds were screened for different biological activities connected with potential treatment of AD. Active compounds are studied in more detail (e.g. type of inhibition, docking studies, logBB etc.).

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FG18

SEPARATION OF STEREOISOMERS FROM *ZEPHYRANTHES CITRINA*

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Zephyranthes is a genus of bulbous perennial plants belonging to Amaryllidaceae family that consists of about 90 various species. Phytochemical screening of their biologically active constituents revealed diverse group of compounds especially Amaryllidaceae alkaloids having various pharmacological activities including anticancer, anticholinesterase, antiviral, antifungal and anti-inflammatory activity. To date, ten alkaloids of various structural types have been reported in *Zephyranthes citrina*[1].

So far, 26 alkaloids from 30 kg fresh bulbs of *Zephyranthes citrina* have been isolated by liquid-liquid extraction and commonly used chromatographic methods. All compounds were identified by MS and NMR techniques. Several alkaloids were obtained in the mixture of isomers. Haemanthidine, an alkaloid of *β*-crinane structure type, has been isolated in our lab in form of mixture of 4 isomers. Within previous studies this alkaloid showed promising cytotoxic activity against different cancer cell lines. The aim of this study was separation of individual isomers and study of their biological activity, since the biological activity of individual isomers is unknown. Direct resolution of haemanthidine into its enantiomers was achieved by normal-phase TLC on silica gel plates impregnated with optically pure *L*-tartaric acid and *L*-histidine as chiral selectors. The mobile phase that enabled the best resolution was combination of cyclohexane-ethyl acetate-isopropanol-diethylamine (45:45:5:5), the spots were detected with Dragendorff's reagent and under UV light. The studies of biological activities of each isomer are underway.

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FG19

BIOLOGICAL EVALUATION OF ALKALOIDS ISOLATED FROM *NARCISSUS CV.* CARLTON AND ANTIPROLIFERATIVE POTENTIAL OF THEIR SEMISYNTHETIC DERIVATIVES

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Plants of genus *Narcissus* L. the most common genus of the Amaryllidaceae family have been used in traditional medicine worldwide. Most of the species can hybridize and some hybrids cultivars have been reported as potential sources of galanthamine and further Amaryllidaceae alkaloids (AA).[1] *Narcissus pseudonarcissus cv.* Carlton is an abundant species of *Narcissus* L. genus, often used for commercial extraction of galanthamine which is the most active AA used in the clinical management of mild to moderate stages of Alzheimer's disease (AD). So far, thirteen known AA have been isolated from *Narcissus pseudonarcissus cv.* Carlton. One undescribed isomer of hippeastrine and three new compounds belonging to belladine structure types have been isolated. Compounds isolated in sufficient amounts were screened for acetylcholinesterase (AChE), butyrylcholinesterase (BuChE), prolyloligopeptidase (POP), glycogen synthase kinase-3 beta (GSK3β) and beta-secretase1 (BACE1) inhibition activity. Hippeastrine isomer and new compounds named carltonine A, carltonine B, and carltonine C demonstrate BuChE inhibition activity in μM and nM concentrations (10.07μM, 91nM, 3nM and 14.84μM respectively).[2] The next part of current study was the preparation of semisynthetic derivatives of galanthamine and screening of their biological activities connected with AD and oncological diseases.

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FG19

NEUROPROTECTIVE ACTIVITY OF *NUPHAR LUTEA* L. ALKALOID

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During screening of potential plant inhibitors against human acetylcholinesterase (*h*AChE) and butyrylcholinesterase (*h*BChE) at our department, a *Nuphar lutea* alkaloidal extract demonstrated potent and selective *h*BChE inhibitory activity (IC_{50} value of 11.73 ± 1.05 μg/mL), against *h*AchE was inactive (IC_{50} value > 100 μg/mL). From a dried plant material of *N. lutea* (12.25 kg; leaves and rhizomes) was prepared a summary ethanol extract (37.7 g) which was subsequently fractionated with diethyl ether (Et_2O-A; 1.7 g and Et_2O-B; 34.4 g), chloroform ($CHCl_3$-B; 0.34 g), and ethyl acetate (EtOAc-B; 0.95 g) by liquid-liquid extraction. The Et_2O-B was separated by columm chromatography on neutral alumina with step elution using petroleum ether, chloroform, and ethanol to collect 266 fractions which were monitored by TLC analysis and 22 joined fractions were obtained. Subsequently, 5 fractions were separated by using different chromatographic techniques (flash chromatography and preparative TLC) to isolate five pure alkaloids (thiobinupharidine, neothiobinupharidine, two unpublished diastereomers of thiobinupharidine, and one unpublished diastereomer of deoxynupharidine). Their structures were elucidated with mass spectrometry (EI, ESI), NMR, and optical rotation. *h*AChE and *h*BChE inhibitory activity of pure alkaloids was determined using a modified Ellman's method[1]. The diastereomer of deoxynupharidine showed moderate activity against *h*BChE with an IC_{50} value 69.30 ± 5.00 μM, other compounds were considered inactive (IC_{50} values > 100 μM).

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