AGRICULTURAL UNIVERSITY OF GEORGIA
TBILISI FREE UNIVERSITY
ASSOCIATION OF PROFESSIONAL CHEMISTS OF GEORGIA

DEDICATED TO 150TH ANNIVERSARY
OF DAVID SARAJISHVILI

6-TH INTERNATIONAL CONFERENCE OF YOUNG SCIENTISTS

"Chemistry, agrochemistry and biology: Modern trends and achievements"

Dedicated to anniversary of David Sarajishvili

JUNE 18-21, 2023
TBILISI, GEORGIA

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June 18-21, 2023

Tbilisi, Georgia

Welcome!

On behalf of all Organizers we have a pleasure and privilege to invite you to participate in the 6th International Conference of Young Scientists - "Chemistry, Agrochemistry and Biology: Modern Trends and Achievements" (ICYS-2023), that will be held on the June 18th-21st, 2023 in Tbilisi, Georgia.

The Conference is the 6th in a series of international conferences, organized by the Agricultural University of Georgia and Association of Professional Chemists of Georgia.

The scientific program will provide an opportunity for participating young scientists to exchange new ideas and information on many issues covering wide spectrum of chemistry topics. High-profile plenary and keynote lectures will be provided by outstanding scholars invited from prestigious research centers.

The conference will be an occasion for the participants to make new acquaintances, share findings and strengthen networks and research collaboration. The Organizing Committee is sincerely making full efforts to feature wide-ranging and excellent scientific programs to ensure that you are up-to-date with the latest developments and on current research in general fields of chemistry.

We also plan to present a breathtaking and an enthralling social program where you will fully enjoy visiting the sights of Tbilisi and Georgia as well as the pleasant interaction with other participants and colleagues, so that all delegates and accompanying persons can carry home good memories of the occasion in Tbilisi and in the countryside. Therefore, we encourage you to take this chance to explore the many manifestations of the beautiful City of Tbilisi and experience the exciting ancient Georgian culture.

All members of the organizing committee hope all of you will join us at ICYS-2023 in Tbilisi, Georgia.

We look forward to seeing you in Tbilisi in June, 2023.

Vakhtang Lejava,

Chair of organizing committee
Professor
Rector of Agricultural University of Georgia

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Plenary Lectures

PL 1. SULFONATED AROMATIC IONOMERS FOR POLYMER ELECTROLYTE MEMBRANE FUEL CELLS: CURRENT STANDING AND CHALLENGES

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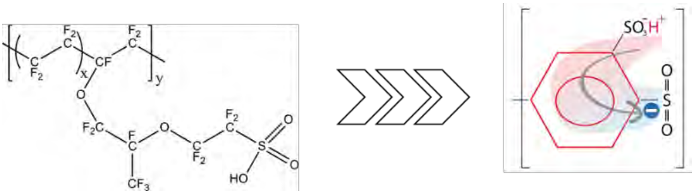
Currently, perfluoro-sufonic acid (PFSA) membranes stay the material of the choice for PEM-fuel cells and PEM-electrolyzers due to their high ionic conductivity, reasonable chemical stability (after doping with radical scavengers, such as cerium oxide) and mechanical robustness. However, PFSA membranes suffer from the drawbacks, such as limited operation temperature due to the relatively low glass transition temperature, significant gas permeability, relatively high cost and environmental concerns associated as with production, as well as with recycling process. This leaves significant space for the development of alternative membrane materials meeting the requirements of specific applications. Hydrocarbon ionomers are considered as an alternative to PFSA materials, which could offer lower gas crossover, higher operation temperature and lower cost. In addition, these materials are expected to have no or low negative impact on the environment. In the presentation will be discussed the historical development of alternative hydrocarbon materials, followed by their current standing and challenges. In addition will be presented some advanced rmade in poly(phenylene sulfone) ionomers.



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PL 2. INSIGHTS INTO THE GRAPE GENOMICS AND WINE AROMAS OF GEORGIA KNOWN AS THE CRADLE OF VITICULTURE

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Georgia, known as the cradle of viticulture, is a home to over 500 indigenous grape cultivars and the country with the earliest archaeological evidence of grape domestication. Chemical analyses of ancient organic compounds absorbed into the pottery fabrics from sites in Georgia, dating to the early Neolithic period, offer the earliest biomolecular archaeological evidence for grape wine and viniculture from the Near East, at ca. 6,000–5,800 BC. Wines produced from Georgian grape cultivars are the oldest in Europe and are distinguished for their high quality, a special aroma, flavor, and taste. In 2013, ancient Georgian traditional Qvevri wine-making technology was assigned the status of National Monument of Intangible Cultural Heritage by UNESCO. DNA based technologies have been developed to explore various scientific fields and are extensively used in molecular evolutionary and phylogenetic studies of organisms. In grapevine genomics, these technologies enable to unlock the molecular basis of the unique characteristics of Georgian grapes and wines and help define the role and significance of Georgian grapevines in the history of world viticulture.

PL 3. ZEBRAFISH AS A MODEL FOR ANTICANCER DRUG RESEARCH

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Poly (ADP-ribose) polymerase-1 (PARP-1), as well as topoisomerases (Top) nowadays serve as a target for cancer therapy and have been extensively studied in mammalian model systems, however in other vertebrate models remain less characterized. Zebrafish is emerging as an alternative vertebrate model for recapitulation of numerous human diseases including cancer due to its cost effectiveness, high fecundity, transparency of embryos and homology of major organs and cell types to that of mammals. Our studies have shown that Top 2 poisons (doxorubicin and etoposide) do not cause death in 1-day post fertilization (dpf) embryos, however they induce DNA damage as observed by alkaline comet assay. After the detailed examination of this phenomenon, it was shown by fluorescence microscopy that DOX uptake depends on the stage of embryonic development and differs in in vivo and ex vivo systems. We have also revealed some similarities of response towards genotoxic stress induced by Top 1 poisons (rubitecan and irinotecan) and PARP-1 inhibitor olaparib between mammalian and zebrafish systems. It was shown that Top 1 poisons increase mortality of 1 dpf zebrafish embryos and induce DNA damage. It was also demonstrated that PARP-1 inhibitor–olaparib, significantly increased the mortality of rubitecan treated embryos as well DNA damage level. Interestingly, chemical inhibition of tyrosyl-DNA phosphodiesterase -1 (TDP1), the main player in Top 1 cleavage complex repair in mammalian system, did not show any effect on embryo mortality and DNA damage level. On the next step we evaluated the effect of Top 1 poisoning and PARP inhibition on caspase-dependent apoptosis in zebrafish embryos. We have shown PARP-1 apoptotic fragmentation in 5-hour rubitecan treated zebrafish embryos by Western Blotting. For in situ detection of apoptotic cells, whole mount immunofluorescence using anti-activated caspase-3 Abs has been performed. Caspase-3 positive cells were observed predominantly in the brain, eye and notochord area. The amount of caspase-3 positive cells was significantly reduced in rubitecan treated embryos in the presence of olaparib. Collectively, our data introduces zebrafish as a valuable model for anticancer drug research.

PL 4. APPROACHES FOR ELUCIDATING FUNDAMENTAL QUESTIONS OF CHARGE EXCHANGE PROCESSES IN BIOELECTROCHEMICAL SYSTEMS

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Bioelectrochemistry can be defined as a branch of chemical science concerned with electrode reactions of redox active biomolecules as well as electron-proton transfer processes involving biomolecules. During the last decades, this field enjoyed diverse development with impact on many areas in chemistry, from energy storage to understanding biological processes at a fundamental level. Despite remarkable progress in very different directions, researchers are still not able to offer a definitive interpretation of the mechanism of some bioelectrochemical actions.

Three different electrochemical methods offering several well-recognized approaches for understanding charge transfer processes in the systems with biological components are briefly discussed. One of the powerful electrochemical tools is scanning electrochemical microscopy (SECM) which is based on monitoring the surface of the sample by scanning the probe and collecting electrochemical response. SECM was applied to study the nuclear pore complex, proteinaceous nanopore that solely mediates molecular transport across the nuclear envelope between the nucleus and cytoplasm of a eukaryotic cell. Specifically, a nanogap-based approach of scanning electrochemical microscopy was developed to precisely measure the extremely high permeability of the nuclear envelope to a small probe molecule, (ferrocenylmethyl)trimethylammonium. Effective medium theories indicated that the passive permeability of 5.9×10^{-2} cm/s corresponds to the free diffusion of the probe molecule through ~22 nanopores with a radius of 24 nm and a length of 35 nm [1].

Fundamental studies of artificial nano-dimensional biological composites with the participation of self-assembled alkanethiol monolayers deposited on various electrodes and redox-active metalloproteins including copper proteins encompasses different physical regimes and exchange mechanisms of electron transfer reactions [2]. Immobilized copper on a self-assembled monolayer of different types of cysteines grown on graphene electrode were characterized by electrochemical methods such as cyclic voltammetry, potentiodinamic measurement which is based on a continuous change of electrode potential and measurement of resulting current. It was found that the length of cysteine methylene bridge chain does not affect significantly on the composite redox signal. The pH of solutions affected protonation of the amino acid moiety, its ligation strength toward copper (II), and consequently the sensitivity of the electrodes. At pH lower than pH 5, isoelectric point for L-cysteine indicating that the zwitterionic form is predominant, the chelating ability decreased because the carboxylate was protonated and strong electrochemical signal from the Cu(II)/cysteine composite was not expected [3].

For the study of light induced bioelectrochemical processes, the biohybrid electrodes constructed via combination of electrospun 3D indium tin oxide (ITO) with the trimeric supercomplex photosystem I (PSI) and the small electrochemically active protein cytochrome c (cyt c) has been developed. The developed 3D surface of ITO has been created by electrospinning of a mixture of polyelthylene oxide (PEO) and ITO nanoparticles onto ITO glass slides followed by a subsequent elimination of PEO by sintering the composite. Whereas the photosystem I alone showed only small photocurrents at these 3D electrodes, the co-immobilization of cyt c to the electrospun 3D ITO resulted in well-defined photoelectrochemical signals. The scaling of thickness of the 3D ITO layers by controlling the time of electrospinning resulted in enhancement of the photocurrent. For the ITO/PSI/Cyt c electrodes several performance factors have been analyzed: External quantum efficiency correlating the electron generation relative to photon flux incident on the substrate was found to be 0.06% for electrodes prepared with 10 min spinning time and 0.14% for electrodes with 60 min spinning time [4].

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PL 5. LEUCINE-BASED PSEUDO-PROTEINS (LPPS) AS PROMISING BIOMATERIALS

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Scaffold-based systems have become essential in biomedical research, providing possibility to build *in vitro* models which better mimic tissue/organic physiology and pathology. Therefore, synthesis and clinical use of novel biopolymers, as well as the development of relevant scaffold-based platforms offer a promising route toward growing demand in regeneration and transplantation medicine [1].

Due to the lack of tissue/organic regulatory control in the *in vitro* culture systems, cells behavioral events on the surface of the biopolymers has been recognized as self-organization [2]. Thus, to mimic any tissue *in vitro* by combining biomaterials and cells, corresponding cell culture platforms should facilitate self-organization within yielding cell-biopolymer assemblies providing a physiologically relevant micro-environment for cell adhesion and cell migration. Therefore, in the search of physiologically relevant, self-assembly based approach, the nature of the scaffolding biopolymer plays a leading role [1,2].

Artificial biomimetic polymers which, on the one hand, biodegrade to α-L-amino acids and, on the other hand, reveal from low to zero immunogenicity, combine advantageous features of both natural and artificial polymers. In this context, especially promising could be considered relatively new family of biomimetics - pseudo-proteins (PPs) [1,3].

We have previously shown, that nanoparticles produced from two different leucine-based pseudo-proteins (PPs) - 8L6 (composed of L-leucine, 1,6-hexanediol and sebacic acid) and 1L6 (composed of carbonic acid, L-leucine and 1,6-hexanediol) reveal low cytotoxicity with different stable cell lines [4]. As the same PPs can be used for the creation of thin solid films, we presumed, that due to their high biocompatibility they can be considered as a potential scaffolding material. Also, a third type of PP film was used, which is made from a copolymer - $(1L6)_{0.7}$-$(8L6)_{0.3.}$

As substrate microtopography is known to affect cell physiology [2], we have studied the surface topography of all three PP films by scanning electron microscopy (SEM). SEM examination gave us a clear picture, that at a nanoscale level both - pore number and pore diameter range was different for all three films.

SEM has been used to evaluate cell adhesion and cell spreading on the substrate according to morphological parameters. Experiments were performed using two types of cells – a primary mouse skin fibroblasts (pMSF) and a murine monocyte/macrophages cell line RAW264.7. Obtained images for both types of cells demonstrated a prominent adhesion and a perfect cell spreading of cells on PPs.

Evaluation of actin cytoskeleton distribution in cells grown on PPs films has revealed a high number of both focal adhesions and well distinguished motility-associated structures such as filopodia and lamellipodia, indicating a high affinity of PP substrates towards both cell types used in the experiments.

Further investigation of PP films effect on cell functional parameters (such as cell proliferation, cell motility, mitotic index, functional polarization of macrophages) revealed, that PP films have an important influence on cell physiology, which was differential depending on a particular PP film type. These dissimilar effects might be due to the detected differences in surface topology and needs to be investigated in more detail.

Overall, our data suggests, that all three PPs used in the study can be considered as a promising scaffolding material for tissue engineering and tissue regeneration tasks.

Supported by Shota Rustaveli National Research Foundation, Project FR-21-11587

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PL 6. PSEUDO-PROTEINS: DESIGN AND BIOMEDICAL APPLICATIONS

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Among the naturally occurring biodegradable polymers, applied for biomedical purposes, proteins are taken a leading position – they are suitable for both surgical and pharmaceutical applications owing to their innate affinity to tissues, enzymatic biodegradability with releasing α-Amino Acids (α-AAs) which could be assimilated by the organism promoting in that way tissue regeneration. However, the proteins have some serious shortcomings among which the most important is immunogenicity that is attributed to their molecular architecture. New generation of α-AA based biodegradable polymers, so-called "Pseudo-Proteins" (PPs) have a new macromolecular architecture less recognizable by the immune system of the living organism. The key monomers to build up PPs are diamine-diester monomers made of α-AAs and diols. Several classes of PPs both regular and functional ones having the widest range of material properties have been designed. PPs, like proteins, release α-AAs upon the biodegradation and could be considered for numerous sophisticated biomedical applications in regenerative medicine, pharmacy, etc.

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PL 7. 3D/4D Organization of r-Chromatin: A Multifold Loop Model as Unraveled by Volume Electron Microscopy of UBTF1 and UBTF2 Isoforms

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Upstream binding transcription factor (UBTF) is a key co-regulator of the RNA polymerase I by constituting an active initiation complex on rRNA genes. As an architectural transcription factor, UBTF plays a role in the maintenance of “open” r-DNA, in its bending, looping and folding. It exists as two splicing variants UBTF1 and UBTF2 which cannot be discerned with antibodies raised against UBTF. Meanwhile, no data exist on their ultrastructural localization, their 3D organization or their reorganization during of rRNA transcription inhibition induced during mitosis or by drugs. As UBTF is a useful marker to trace rDNA genes, we used these data to improve our previous model of 3D organization of rDNA gene within fibrillary centers (FCs). We investigated the ultrastructural localization of UBTF in cells synthesizing GFP-tagged UBTF1 or UBTF2 isoforms by using anti-GFP antibodies and pre-embedding nanogold strategy. This strategy was chosen to obtain a strong signal to noise ratio allowing to perform precise electron tomography. In control cells, these two isoforms are mainly localized within FCs but showed a different repartition. Electron tomography demonstrated that UBTF isoforms are disposed as fibrils which are folded in loop-like structures. Thus, UBTF1 and UBTF2 show a similar distribution along extended 3D loop-like structures. Finally, when rRNA synthesis is inhibited during Actinomycin D treatment or mitosis, their localization is identical and they remain organized as extended 3D loop-like structures. Altogether these data suggest the role of UBTF in the loop-like packaging of active and inactive rDNA genes within FCs.

Oral Presentations

OP 1. SYNTHESIS AND CHARACTERIZATION OF SULFONATED POLY(PHENYLENE SULFONE)S INCORPORATING NON-SULFONATED MICROBLOCKS FOR IMPROVED PEMFC PERFORMANCE

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Proton-Exchange Membrane Fuel Cells (PEMFC) convert the chemical energy of reactants directly into electricity. PEMFCs are highly efficient and emit no pollutants [1. 2], making them a promising solution for transportation and portable energy applications in response to climate change [3, 4]. Perfluorosulfonic acid (PFSA) ionomers, such as Nafion, are currently used as the benchmark membrane due to their balanced properties, but they suffer from several drawbacks, including loss of mechanical strength at high temperatures [5] and questionable environmental compatibility [6]. This has led to efforts to develop alternative membrane materials, including sulfonated hydrocarbon-based polymers, which offer lower cost, low fuel permeability, and high mechanical and thermal stability. Sulfonated poly(phenylene sulfone)s (sPPS) are of particular interest due to their high oxidative and hydrolytic stability [7, 8], higher acidity of sulfonic acid groups, and rigidity of the backbone allowing for the preparation of water-insoluble ionomers with high ion-exchange capacity (IEC).

While sPPS ionomers with high IEC (e.g. sPPS-220, IEC = 4.5 meq/g) [9, 10] have good transport and stability properties, they are water-soluble, brittle and exhibit excessive swelling under high humidity conditions. There are two approaches to address these issues: synthesis of multiblock copolymers and an acid-base blending strategy. While these approaches showed promise in reducing water uptake (WU) and improving viscoelastic properties [11, 12], they also had limitations. To overcome these limitations, our group have synthesized water-insoluble sPPS ionomers with high IEC by copolymerization of sulfonated diflurodiphenyl sulfone, diflurodiphenyl sulfone and lithium sulfide [13]. However, excessive swelling remains an issue that needs to be addressed. The importance of reducing WU of PEM in fuel cells is critical to improve their durability and performance.

The problem of excessive WU in sulfonated poly(phenylene sulfone)s has been addressed through the development of new non-sulfonated difluoro-monomers that are longer in length and can be used for polymerization. These monomers have been successfully used to synthesize sulfonated poly(phenylene sulfone)s with specific non-sulfonated microblock segments that exhibit strong interaction between the hydrophobic microblocks. This interaction can lead to a reduction in water uptake, thereby solving the problem of excessive swelling.

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OP 2. PSEUDO-PROTEIN BASED NANOPARTICLES FOR OCULAR DRUG DELIVERY: EVALUATION OF DRUG ENCAPSULATION EFFICIENCY AND DRUG RELEASE

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Ocular drug delivery for treating various eye diseases still remains a challenge in ophthalmology. One promising way of overcoming this problem is to use the nanoscale biodegradable drug carriers that are able to safely deliver pharmaceuticals directly to the locus of disease and maintain a therapeutic concentration of drug for a long time. The goal of the present study was the preparation of drug (dexamethasone, DEX) loaded pseudo-protein nanoparticles (NPs) and investigation of drug encapsulation efficiency and drug release kinetics. DEX-loaded pseudo-protein NPs (DEX-NPs) were successfully prepared by nanoprecipitation method. DEX-NPs were characterized by size (average diameter), size distribution (polydispersity index), and surface charge (zeta-potential) using DLS technique.

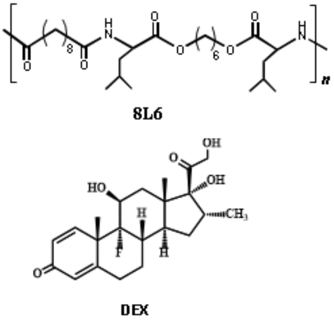

Figure 1. Chemical structures of pseudo-protein 8L6 and the drug DEX

DEX encapsulation characteristics were determined using the UV-spectrophotometric method and the kinetics of DEX release from the DEX-NPs was studied according to the dialysis method in PBS at 37°C. The obtained results showed that the size of DEX-NPs varies within 143.6 – 164.1 nm depending on the DEX content during the preparation. The DEX incorporation characteristics –

encapsulation efficiency and actual drug loading were high enough and reached 55.1 and 10.2%, respectively. The kinetics of DEX release from the DEX-NPs showed a typical biphasic release pattern - an initial burst release and further much more continuous slow release. Based on the obtained data we can conclude that the elaborated DEX-NPs have potential for the application in ophthalmology as ocular drug delivery nanocarriers.

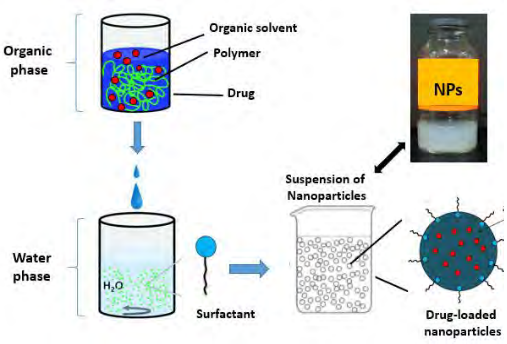

Figure 2. Scheme of the nanoprecipitation method

Acknowledgements: This work was supported by Shota Rustaveli National Science Foundation of Georgia (SRNSFG) [YS-21-2215]. The authors gratefully acknowledge Mr. David Makharadze from Polytechnic University of Catalonia (Barcelona, Spain) for providing TEM images of drug loaded pseudo-protein NPs.

OP 3. ENLARGING THE LIBRARY OF DEGRADABLE TRIAZOLE POLYMERS *VIA* „CLICK“ POLYMERIZATION

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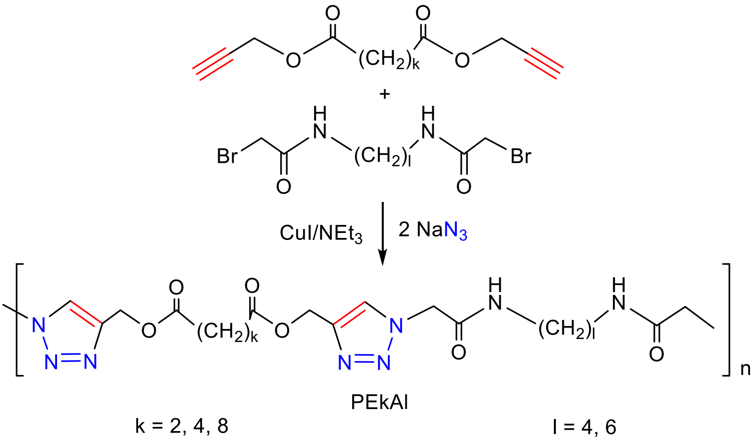
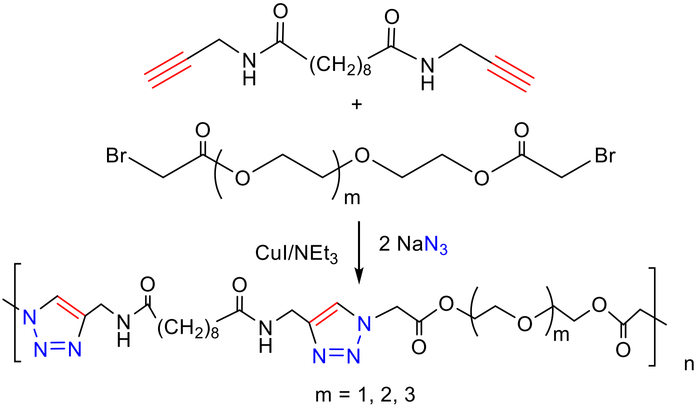
In this work, new AA-BB-type 1,2,3-triazole containing aliphatic poly(ester amide)s (see Scheme 1) and poly(ester ether amide)s (see Scheme 2) were synthesized *via* three-component two-step Cu(I)-catalyzed „click“ step-growth polymerization process using dibromide and diyne monomers in the presence of sodium azide according to the new synthetic strategy that we had previously developed [1,2]. The structure of the obtained new degradable ester polymers was confirmed by standard methods such as FTIR and NMR techniques, and solubility behaviour of the „click“ polymers was studied.



Scheme 1. Synthesis of poly(ester amide)s

As it was anticipated, „click“ poly(ester amide)s showed very poor solubility in common organic solvents presumably due to the presence of rigid amide bonds along with triazole rings in the backbone. Introduction of additional ether bonds in the polymeric main chain significantly improved the solubility of the new triazole polymers: click poly(ester ether amide)s revealed quite good solubility in common organic solvents like DMSO, DMF, DMA, and NMP. The obtained results underline the suitability of our new synthetic strategy for obtaining various classes of 1,2,3-triazole containing hetero-chain degradable click polymers with triazole rings in the backbone and enlarge the library of available click polymers that are promising for wide range of biomedical applications.



Scheme 2. Synthesis of poly(ester ether amide)s

Acknowledgements: This work was supported by Shota Rustaveli National Science Foundation of Georgia (SRNSFG) [YS-21-2522]. Authors acknowledge Professor of Agricultural University of Georgia, Dr. Giorgi Titvinidze for assistance with NMR measurements.

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OP 4. REALGAR As_4S_4 QUANTUM DOTS (RQDs)

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Quantum dots (QDs) are semiconducting nanocrystals that have unique optical and electronic properties due to their small size that range in size from 1 to 10 nanometers (nm) and quantum confinement effect. They have a wide range of potential applications in various fields, including biomedicine, optoelectronics, and energy conversion. QDs are highly fluorescent and can emit light in a range of colors depending on their size and composition. Their narrow emission spectra and high quantum yield make them ideal for biological imaging and sensing applications. Ellipsoidal and lens-shaped quantum dots are most remarkable systems which as limiting cases can be transformed to either quantum wells or quantum wires. [1-3]. Chalcogenide quantum dots are of practical interest since they possess the spherical and ellipsoidal shape and appear to be utilized as a source of polarized irradiation. Arsenic sulfide quantum dots have been the subject of numerous studies due to their unique properties and potential applications in various fields [4-5]. The researchers found that the arsenic (II) sulfide quantum dots displayed high stability and low toxicity. In addition to their use in photovoltaics, photodetectors, and optoelectronics, they have also shown promise in biomedicine and sensing applications. Recently, much attention has been given to its cytotoxic effect on a variety of cancer cells and its effect on many kinds of leukemia such as acute promyelocytic leukemia. Yakunin et al. (2015) reported on synthesizing and characterizing lead sulfide nanocrystals encapsulated in arsenic sulfide shells. Wang et al. (2011) report arsenic (II) sulfide quantum dots synthesized using a simple wet-chemical method from bulk arsenic (II) sulfide.

As a bulk chalcogenide, we opted realgar As_4S_4 (98% relgar) from realgar-orpiment ore of Georgia republic [5]. Realgar is a member of sulfide mineral known as “ruby sulphur” or “ruby arsenic” with the chemical formula As_4S_4, often in association with the related mineral orpiment As_4S_6. Realgar is known to be used as a traditional Chinese medicine for thousands of years. Realgar QDs could be an alternative for the bulk realgar owing to their water-solubility and efficient PL.

In this study realgar (As_4S_4) QDs were synthesized via a wet chemical method from its bulk through cluster -mediate transformation in a coordinating solvent octylamine with assistance of an acid (e.g. acetic acid). RQDs are exhibit bright blue photoluminescence (PL) in a short wavelength window (<< 480nm) with high quantum yield up to 80%. In addition, a flexible inorganic/organic hybrid composite film was fabricated by incorporation of realgar QDs into starch and cellulose matrix. The resulting film presents excellent PL. The ability to control the size and morphology of these materials through synthetic methods makes them even more attractive for use in various applications.

However, it is important to note that the potential toxicity of these materials must be carefully studied. Further research is needed to fully understand the toxicity of arsenic sulfide quantum dots and ensure their safe use.

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OP 5. EVALUATION OF THE CENTRAL-METAL EFFECT ON ANTICANCER ACTIVITY AND MECHANISM OF ACTION OF ISOSTRUCTURAL Cu(II) AND Ni(II) COMPLEXES CONTAINING PYRIDINE-2,6-DICARBOXYLATE

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Metal ions have a significant role in the biological processes of the body as the vital activities of the cell and enzymes are organized by their inherently existent metals. Therefore, through many decades, metal-based compounds have been evaluated for the treatment of various diseases. Two Cu(II) (C1) and Ni(II) (C2) complexes were designed through the one-pot reaction of pyridine-2,6-dicarboxylic acid and 2-amino benzimidazole respectively with copper(II) nitrate hexahydrate and nickel(II) nitrate hexahydrate. Both complexes were characterized by single-crystal X-ray diffraction and the distorted octahedral geometry was recognized for them. The anticancer evaluations showed that these compounds have a different inhibition effect on the tested cell lines and it was concluded that the type of central metal could affect the inhibitory effect and action mechanism of the compounds as an anticancer drug.

The assay of apoptosis- and autophagy-related proteins indicated that bimodal death can be suggested through mitochondria-mediated apoptosis and autophagy pathways in BEL-7404 cells treated with the complexes, although each of these processes may be more prominent depending on the type of central metal in the complexes.

OP 6. SYNTHESIS OF NEW HYBRID AZO AND SPIRO PHOTOCHROMIC COMPOUNDS

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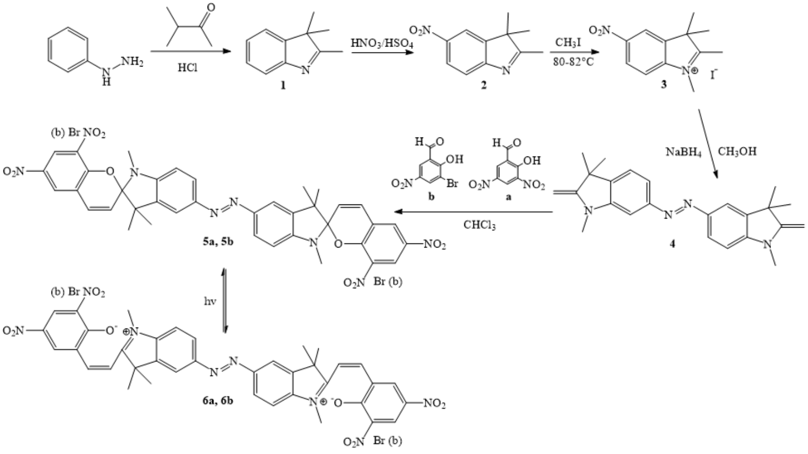
Photochromic compounds are of great importance due to their ability to undergo reversible color changes upon exposure to light. This property makes them valuable in various applications, such as photochromic lenses, optical switches, data storage devices, and sensors. The ability to control their optical properties through light irradiation offers opportunities for developing advanced technologies in fields like optics, materials science, and photonics [1].

Herein we report the syntheses of two new photochromic bis-spiro diazenes, (5a) (*E*)-1,2-bis(1’,3’,3’-trimethyl-6,8-dinitrospiro[chromene-2,2’-indolin]-5’-yl)diazene and (5b) (*E*)-1,2-bis(8-bromo-1’,3’,3’-trimethyl-6-nitrospiro[chromene-2,2’-indolin]-5’-yl)diazene. The figure shows the route beginning with a typical Fischer indole synthesis using phenylhydrazine and 3-methylbutan-2-one.



Intermediary and final products were studied with TLC, IR and NMR spectroscopy. The illumination of compounds 5a and 5b and the subsequent formation of 6a and

6b merocyanine forms was analysed by UV absorbance. Further studies on the synthesized products are ongoing.

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OP 7. ATOM TRANSFER RADICAL REACTIONS AS A TOOL FOR SYNTHESIS OF PHYSIOLOGICALLY ACTIVE CARBOCYCLES

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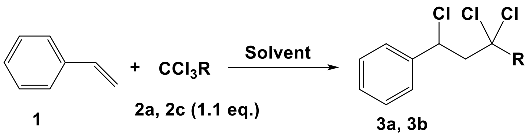
Small carbocycles are basic structural elements in a wide variety of naturally occurring compounds and in a number of physiologically active substances. However, the synthesis of these compounds is often difficult due to the strained nature of the rings.

Transition metal-catalyzed atom transfer radical (ATR) reactions have been shown to be one of the most powerful methods for synthesizing carbo- and hetero-cycles. ATR reactions are typically carried out in the presence of a transition metal catalyst, a radical initiator, and a co-reagent. The transition metal catalyst abstracts a hydrogen (halogene) atom from the co-reagent, generating a radical. The radical then reacts with the alkene substrate to form a new carbon-carbon bond. The final product is a carbocycle with the desired number of carbon atoms. ATR reactions are versatile and can be used to synthesize a wide variety of carbocycles. They are also relatively simple to perform and can be carried out under mild conditions. Thus, ATR reactions have become an important tool for the synthesis of small carbocycles. [1]

In the scope of current investigation, we have demonstrated the crucial role of the solvent in catalytic activity of the reaction. Different research groups reported that more polar solvents, such as DMF or DMSO, are controlled the activity of copper salts and stabilized reaction intermediates; they even can change the structure of catalyst by coordination with metal center. [2,3] The crucial role of solvent in ATR reactions as a compatible co-ligand, homogenizing and stabilizing media for catalyst was reported. [4]

To test the scope of new procedure with DMSO-solvent/co-ligand was chosen well-known ATRA reaction of trichloroacetic acid derivatives to styrene.

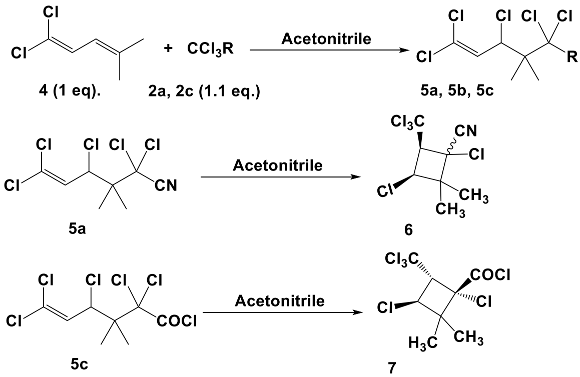


R = a) CN, b) CO_2Et

Cat. CuBr/Piperidine (0.1 eq.)

DMSO extremely increased the activity of catalytic complex. The new catalytic system allows decreasing reaction duration several times, as well as decrease reaction temperature from high to moderate. Reaction have provided high yield and selective formation of desired product. Similar activity was observed for all investigated reactions. New catalytic system allows using fewer active substrates and reagents for ATRA reactions by providing more variety of different products for further use. Further transformations of obtained products bring to a number of new agrochemicals and drugs with improved properties.

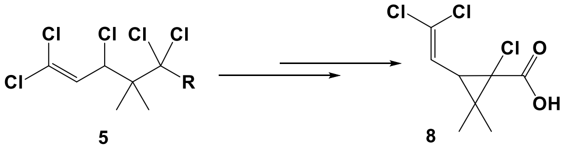
Previously we have published the synthesis of cyclobutane carboxylic derivatives initiated by ATRA and following ATRC reactions in coupling reaction of 1,1-dichloro-4-methylpenta-1,3-diene with trichloroacetic acid derivatives. [1] Even though the intramolecular cyclization provides highly efficient methodology for synthesis of highly functionated cyclobutanes, 1 to 1 addition adduct also has its own focus of interest. Simple 1,3-dehalogenation of α,α,γ-trichlorocarboxylic acid derivative and following hydrolysis lead to formation of subsequent cyclopropane ring subunit – chloropermethric acid.



R = a) CN, b) CO_2Et, c) COCl

Cat. CuBr/Piperidine (0.1 eq.)

By the similar way have been synthesized chloro-cyclobutane carboxylic acid. On the base of 1-chloropermethrinic (norpermethrinic) acid (8) have bin develop a number of insecto-acaricides pyrethroidal structures. [5] The preparative form on the base of chloro-cyclobutane carboxylic acid was called "Cyclobytin" and has been tested in labor and farms. The results show that "Cyclobytin" have high pesticide activity and the synergistic composition comprising by active ingredients "Cyclobytin" and "Cypermetrin" show nearly twice high activity than etalon (active ingredient – "Cypermetrin"). [6]



For preliminary estimation of physiological activity of newly synthesized compounds we have used AutoDock 4.0 computer modeling suite for automated docking and in combination with reconstruction of the simple membrane system using self-assembled lipid bilayers to estimate the influence of changes of the molecular structure of drugs and receptors/channels on kinetic changes in the functions of receptors/channels. These studies include the experiments revealing the influence of new drags on potential dependent opening and closing of ion channels.[7]

We presented the possibility of application ion-channels reconstitution in conventional planar BLM and metal support (s BLM). The joint application of extracted and purified membrane ion-channel proteins and lipids of bovine brain probably brings to self-assemble of proteins domain, helices and side-chains into BLM structure forming the model of native ionic channels. S-BLM forming electrodes (diameter 0,3 mm) distinguish by easy preparation technology and application and provides stability of received BLM.

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OP 8. INVESTIGATING THE PHOTOELECTROCHEMICAL BEHAVIOR OF BIS-AZO DYES

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Dye-Sensitized Solar Cells (DSSCs) are known for their simple fabrication, eco-friendliness, flexibility, and low cost. One of the ways of optimizing DSSCs is by alternating the sensitizing pigments. The goal of this research is to examine bis-azo dyes on the base of 4-amino antipyrine. Azo dyes as the largest group of synthetic dyes occupy a significant volume of dye chemistry produced nowadays [1]. Azo dyes are the most important synthetic colorants widely used in the textile, food pharmaceutical, cosmetic, and leather industries and play a crucial role in the printing market. Besides this, azo dyes are used in biological-medicinal studies [2, 3], and exploitation and the importance of azo dyes may increase in the future. The studied dye is synthesized in two steps: diazotization of 4-amino antipyrine and then coupling with various azo components. Then, this dye is applied on a mesoporous surface that is developed by spin-coating of Indium Tin Oxide (ITO) nanoparticle suspension on an ITO glass substrate. Spin-coating ITO allows for the creation of a three-dimensional surface, which increases surface area, in turn increasing the substrate's effectiveness. Afterward, the assembled systems are tested for photoelectrochemical activity under visible light with different intensities. The system is also tested with cyclic voltammetry. The measurements are made using Zahner Photoelectrochemical workstation. The results show that the mesoporous surface increases the system's efficiency. The system is also sensitive to increasing the light intensity, which consequently increases the subsequent signal. The changes in the applied system potential also changes the photoelectrochemical signal. Possible explanation of photosensitive response mechanisms of the composite system is attempted.

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OP 9. REWORKING THE ^{1}H NMR METHOD FOR GASOLINE QUALITY CONTROL TO FIT SAMPLES ON THE GEORGIAN MARKET

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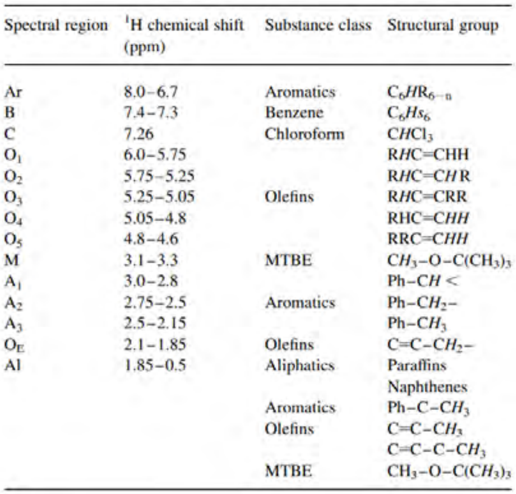
Following the 2020 adoption of EU regulations concerning automotive fuel quality in Georgia [1], having a quick, reliable and cheap method for routine analysis of gasoline remains a challenge for the Department of Environmental Supervision.

A well-known ^{1}H NMR method for gasoline composition analysis [2] was altered to fit the distinctive characteristics of Georgian automotive fuels. This study utilizes the same assumptions and principles, namely, the average group molecular weight approach and the relative-content concept involving aliphatic, olefinic, and aromatic fractions as well as oxygenates and benzene content. The figure shows the regions of interest used for normalization [2]. The equations governing analysis of spectra have been modified to account for high concentrations of ethanol and MTBE in the gasoline samples found on the Georgian market. 18 samples from Gulf, Wissol, Rompetrol, Lukoil, Socar and Connect were analysed. The findings of the ^{1}H NMR method showed 97% confidence with regards to benzene, MTBE and ethanol when checked against results of standard addition methods.



Spectral region	^{1}H chemical shift (ppm)	Substance class	Structural group
Ar	8.0–6.7	Aromatics	C_6HR_{6-n}
B	7.4–7.3	Benzene	C_6Hs_6
C	7.26	Chloroform	$CHCl_3$
O_1	6.0–5.75	Olefins	RHC=CHH
O_2	5.75–5.25		RHC=CHR
O_3	5.25–5.05		RHC=CRR
O_4	5.05–4.8		RHC=CHH
O_5	4.8–4.6		RRC=CHH
M	3.1–3.3	MTBE	CH_3–O–C$(CH_3)_3$
A_1	3.0–2.8	Aromatics	Ph–CH <
A_2	2.75–2.5		Ph–CH_2–
A_3	2.5–2.15		Ph–CH_3
O_E	2.1–1.85	Olefins	C=C–CH_2–
Al	1.85–0.5	Aliphatics	Paraffins
			Naphthenes
		Aromatics	Ph–C–CH_3
		Olefins	C=C–CH_3
			C=C–C–CH_3
		MTBE	CH_3–O–C$(CH_3)_3$

If continued testing against ISO standards also yield favourable results, the modified ^{1}H NMR method could be considered to be recognized as a national standard, aiding the Department of Environmental Supervision in their efforts to control the quality of automotive fuel in Georgia.

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OP 10. NATURAL CYCLIC PEPTIDES FROM DBAASP DATABASE

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Antimicrobial peptides (AMPs) are a diverse group of naturally occurring molecules that actas a part of innate immune system. They hold great promise as potential agents to combat microbial resistance, as microorganisms face more difficulties in developing resistance towards AMPs compared to antibiotics. The Database of Antimicrobial Activity and Structure of Peptides(DBAASP) serves as a comprehensive repository for both structural and experimental data on AMPs, including antimicrobial or cytotoxic activities and spatial structures. The DBAASP tools enable users to calculate peptide physicochemical properties and predict biological activity basedon machine learning algorithms and the data stored in the database.

However, the therapeutic potential of AMPs is limited by two intrinsic challenges: membrane impermeability and poor *in vivo* stability. Macrocyclization, a process that enhances the pharmacological properties and bioactivity of peptides, presents an effective strategy to overcome these limitations. Macrocyclic peptides have emerged as attractive drug candidates, especially considering that many clinically approved cyclic peptides are derived from natural product scaffolds. Nature offers solutions to the challenges faced by AMPs, and exploring the vastrepertoire of cyclic peptides can provide valuable insights.

DBAASP also serves as a repository for cyclic peptides, currently encompassing informationon 438 non-ribosomal and 1307 ribosomal cyclic peptides. Analyzing this data according to peptide length, amino acid composition, cyclization bonds, and mechanisms of action holds significant potential for advancing our understanding of the small cyclic peptides that nature has provided to defend living organisms.

Acknowledgment. This work was supported by Shota Rustaveli National Science Foundation of Georgia (SRNSFG) [grantnumber FR-21-3368].

OP 12. DEVELOPMENT OF PSEUDOPROTEINS MODIFIED WITH POLYAMIDES – POLY(ESTER AMIDE-*CO*-AMIDE)S

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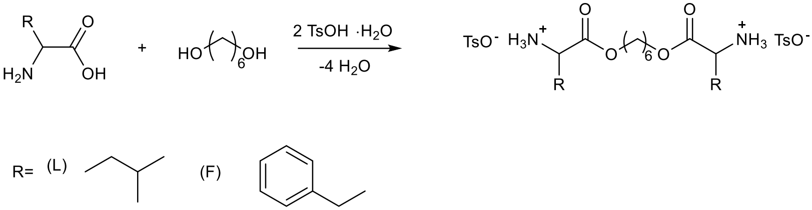
The development of synthetic chemistry in the 20th century was followed by the creation of synthetic polymers, which are characterized by high technical properties and low price. However, their uncontrolled accumulation and the resistance of these materials to chemical or biological degradation caused environmental issues. Every year, only one third of polymer waste is recycled, and the rest is collected in landfills or burned, which cannot completely exclude damage to the ecosystem. It is estimated that the production of polymer products will reach 500 million tons per year by 2050. This created demand for materials that degrade and "disappear" after performing the assigned function, without polluting the environment. Biodegradable polymers (**BP**) belong to such materials. These materials can break down into natural components through the action of microorganisms, enzymes, or other biological processes, thereby reducing the environmental impact of plastic waste [1-4].

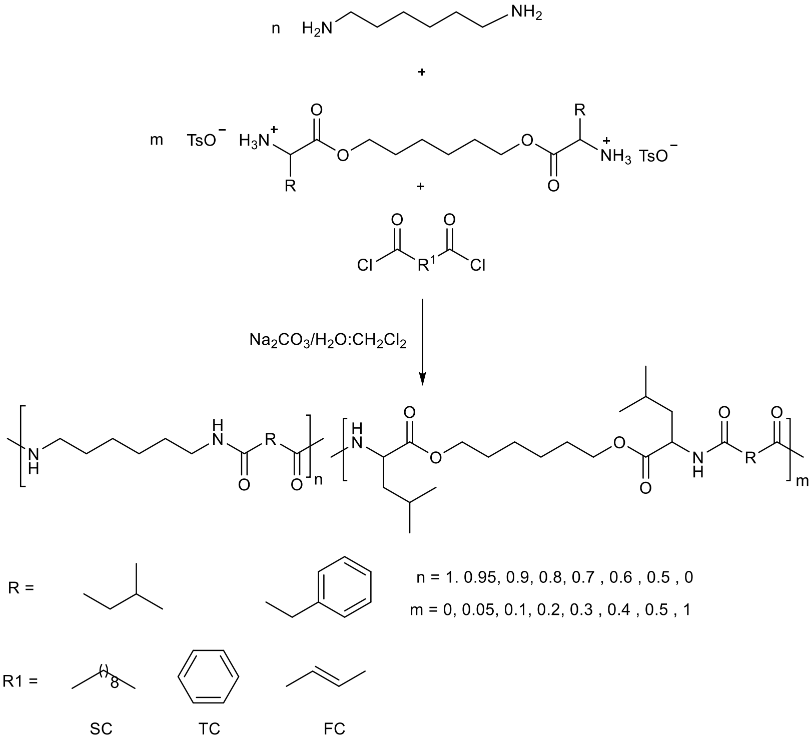
One of the ways to increase the biodegradability of polymers is to introduce highly hydrolyzable groups in their structure. The outstanding classes of heterochain polymers with these parameters are polyamides (PA), the so-called Nylons. Their high degree of crystallinity and strong intermolecular interactions between bonds of polymer chains significantly increase the mechanical properties of polymers. Their low cost makes them attractive for widespread use. however, the stability of amide bonds makes PA difficult to degrade polymers (Hydrolyzable degradation 10^2 times slower than in polyesters)[5-6].

Exceptionally important representatives of biodegradable polymers are Pseudoproteins (**PP**) - a relatively new family of biodegradable polymers based on natural α-amino acids [7]. PP are characterized by non-toxicity of decomposition products, easy synthesis, and environmental friendliness, which leads to high technology and cost-effectiveness (Scheme 1). Their introduction in non-biodegradable polymers makes them more biodegradable and reduces their production costs.



Scheme 1. Synthesis of monomers by direct condensation of amino acids with diols in the presence of p-toluenesulfonic acid

Copolymers of Polyamides were synthesized via interfacial polycondensations between monomers : hexamethyldiamine (**HDMA**) and **TDADE** with diacid chlorides (**SC** - Sebacoyl chloride, **TC** - terephthaloyl chloride, **FC** - fumaryl chloride) (Scheme 2).



Scheme 2. Synthesis PA-*co*-PEA copolymer

Three groups of copolymers were synthesized during the research [**PHS**]$_n$-*co-*[**8L6**]$_m$, [**PHT**]$_n$-*co*-[**TC,L6**]$_m$ and [**PHF**]$_n$-*co*-[**FC,L6**]$_m$. where n:m are different molar ratios of monomers.

The obtained co-polymers were tested for their solubility and film forming properties in different solvents. The structure of the obtained products was confirmed by FTIR and NMR spectroscopy methods. Thermal and mechanical properties were evaluated using a Differential Scanning Calorimeter and Tensile Testing Machine.

Acknowledgment: „This research [PHDF-22-317] has been supported by Shota Rustaveli National Science Foundation of Georgia (SRNSFG)“.

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OP 13. APPLE JUICE FERMENTED BY A CONSORTIUM OF LACTIC ACID BACTERIA

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Dairy products are the main source of probiotics. However, lactose intolerance, which is widespread throughout the world, has led to the development of the enrichment of non-dairy products with probiotic microorganisms.

A consortium consisting of three strains of lactic acid bacteria isolated from apples with probiotic properties (*Lpb. plantarum* 52, *Lpb. plantarum* 74, and *Lpb. plantarum* 76) was used for apple juice fermentation. For this purpose, two durations were selected, in particular, long-term fermentation - 264 hours (Sample №1) and short term-fermentation - 96 hours (Sample № 2). Fermentation was carried out at 37 °C in a thermostat. During this period, the number of viable cells (lg CFU/ ml) was determined by the standard counting method, (the shelf life of probiotic apple juice depends on this parameter); pH values - by pH meter, total phenolic compounds by the Folin-Chiocaltus method and antioxidant activity by the FRAP method.

At the time of inoculation in fermented apple juice for different durations of both sample variants, cell viability was 7.0±0.2 lg CFU/ml. After 96 hours of fermentation, this value was increased to 8.6±0.2 lg CFU/ml, after which the juice of the second variant of the juice sample was placed under refrigeration conditions. On the seventh day after being placed in the refrigerator, it increases to 9.8±0.2 lg CFU/ml, and on the 12th week (84 days) it drops again to 8.6±0.2 lg CFU/ml. Along with the change in the number of viable cells, the pH of the juice also changed, gradually decreasing from 3.65 to 3.55.

At the end of the Long-term fermentation - 264 hours (Sample № 1) the number of bacterial cells was 8.0±0.1 lg CFU/ml. After 4 days in refrigerated conditions at 4 °C, the number of cells increased to 8.9±0.2 lg CFU/ml;

In the following days, it significantly decreased, and on the 21st day (third week) we got 3.9±0.1 lg CFU/ml; Therefore, the shelf life of juice can be considered 2 weeks. The pH of apple juice was 3.65 before the start of fermentation, which gradually decreased to 3.43 under the influence of the consortium, and to 3.31 after the 3rd week of storage at 4 °C.

Total phenolic content and antioxidant activity were also determined in the consortium-fermented apple juice samples. Non-fermented apple juice was used as a control, the content of total phenols was 194.4±9.7 mg GAE/L, and the antioxidant activity was 139.9±6.9 mg AAE/L. In the juice with long-fermented, the content of total phenols increased in the third week after refrigeration and reached 194.4±9.7 mg GAE/L to 282.8±14.1 mg GAE/L in the 9th week after storage, and the antioxidant activity was increased up from 139.9±6.9 mg AAE/L to 154.7±7.7 mg AAE /L.

As for the short-term-fermented apple juice, the content of total phenols increased from 194.4±9.7 mg GAE/L to 304.0+15.2 mg GAE/L. And the antioxidant activity was 118.5+5.9 mg AAE/L on the 12th week after storing the juice in the refrigerator condition.

Conclusion. The viability of lactic acid bacteria was maintained during 12 weeks of storage under refrigerated conditions, suggesting that apple juice is a good substrate for the growth and development of probiotic lactic acid bacteria. With the selected consortium, it is possible to produce probiotic juices, the consumption of which will have a positive effect on human health, especially for people with lactose intolerance.

Acknowledgments: The article was developed within the Sustainable Agricultural and Food Systems (SAFS) Structured Doctoral Program, jointly offered by the University of Kassel (Germany) and the Agricultural University of Georgia. The research was funded by the Volkswagen Foundation and Shota Rustaveli National Science Foundation of Georgia (SRNSFG)–Contract No. 04/47.

OP 14. IDENTIFICATION AND TRANSFORMATION OF STILBENOIDS- DERIVATIVES OF THE RESVERATROL FROM SAPERAVI GRAPE (*VITIS VINIFERA* L.) TO WINE

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Biologically active phenol compounds which are presented in red wine are flavanols and non-phlavanols. They represent wine treatment-profilactic features. Among them the stilbenoids are worth to pay attention, which are characterized by antioxidant, antibacterial, anticarcirogenic and many other activities. Belong to this characteristic research of stilbenoids are actual issue in red wine.

Aim of the research was identification of stilbenoids in Saperavi- Georgian red grape variety, their transformation from grape to wine and determination wine stilbenoid profile. In concret, biochemical indicators of saperavi grape and wine were enriched with following stilbenoids: trans-astringin (glycosides of piceatanol), trans-astringin-in (piceatanol), cis-δ-viniferin (dehidrodimer of trans-resveratrol), α-viniferin (resveratrol trimer), palidol (resveratrol dimer), group of miyabenols(trimer derivatives of resveratrol), among them cis-miyabenol C;

It was established stilbenoids dinamic accumulation process in alcoholic fermentation period, impact of different wine technologies on the concentrations of stilbenoids in red dry wine, there transformation from grape to wine and determination their biological and physiological transformation forms.

It is established astringin and cis-δ-viniferin biological activity-non inhibitor characteristic towards wine yeast strains: Sacch. Vini-kakhuri 42, Sacch vini-rkatsiteli 61, Sacch.chodati-teliani 79; The antiradical activity was determined towards the 2,2, diphenil -picril- hydrasil radical. High antiradical activity revealed tetrameric stilben-hopeaphenol and low antiradical activity – resveratrol glucoside cis-piceid; Stilbenoids trans-astringin, α-viniferin, cis-δ-viniferin non inhibition impact on Lactoenos 450PreAC^R bacteria during the malolactic fermentation process in new saperavi wine material.

OP 15. ANTI-STEATOTIC EFFECT OF RESVERATROL ON EXPERIMENTAL MODELS OF NON-ALCOHOLIC FATTY LIVER DISEASE

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Nonalcoholic fatty liver disease (NAFLD) is the most common liver disease in developed and developing countries. NAFLD is characterized by the accumulation of excess fat and inflammation in the liver. At present, there are no specific drugs approved for NAFLD treatment. The only effective way for the management of NAFLD is lifestyle optimization and caloric restriction (CR). Studies in mice have demonstrated, that a natural polyphenolic compound – resveratrol (RSV) mimics CR, protecting liver cells from the fat accumulation induced by a high fat diet. However, molecular mechanisms mediating resveratrol effects are still under investigation.

We have studied an effect of low-doses resveratrol treatment on lipid metabolism, using lipid-loaded monolayer cultures of hepatocytes (Hepa1-6) and macrophages (RAW264.7), as both cell types contribute to pathogenesis of NAFLD. Cell cultures were treated with low doses RSV (5µM, 10µM) for 3 hours.

According to the obtained results, RSV stimulated a decrease of lipid load in both cell types. It has been revealed, that in hepatocytes, inhibition of Poly [ADP-ribose] polymerase 1(PARP1) as well as inhibition of sirtuin-1 (Sirt1) led to the abrogation of RSV-induced decrease of lipid load. But in case of macrophages, RSV effect was dependent only on Sirt1 signaling pathway. Furthermore, we studied immunomodulatory properties of RSV in both cell types. It has been revealed, that resveratrol exhibited anti-inflammatory properties via both Sirt-1 and PARP1 activation.

Supported by Shota Rustaveli National Research Foundation, Project PhD_F_17_189.

OP 17. EVALUATION OF THE SYNERGISTIC POTENTIAL AND MECHANISMS OF ACTION FOR DE NOVO DESIGNED CATIONIC ANTIMICROBIAL PEPTIDES

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Standard antibiotics are becoming less effective for clinical use due to the emergence and spread of antimicrobial resistance. Hence, there is an urgent need for the discovery and development of novel drugs that can effectively treat bacterial infections induced by particularly drug-resistant Gram- negative bacteria. Antimicrobial peptides (AMPs) have the potential to become new therapeutic agents in the fight against bacterial resistance. Unlike traditional antibiotics, which target specific biomolecules in bacterial cells, AMPs have been shown to exhibit multiple modes of action with non-specific targets and are less prone to induce resistance. *In silico de novo* design of antimicrobial

peptides allow to generate peptides with optimized activity, specificity and stability, In this work weevaluated antibacterial and synergistic properties of *de novo* cationic AMPs (CAMPs) designed usingAntibacterial Peptide Prediction (APP) algorithm and also studied their action on the bacterial cell envelope and cellular DNA.

All tested CAMPs revealed antimicrobial activity irrespective of bacterial inoculum and size and metabolic state of bacteria. For several CAMPs synergy with conventional antibiotics was revealed while all CAMPs were able to potentiate antibiotics depending on bacterial cell density.

Microscopy studies have shown that CAMPs revealing synergistic interactions with antibiotics induce destabilization and disruption of inner and outer membranes of bacterial cell, as revealed by the presence of multiple blebs on bacterial surface. Interestingly, blebbing was partially reverted in the presence of ROS (reactive oxygen species)-scavenger thiourea (TU), meaning that generation ofROS might (at least partially) be responsible for the antimicrobial properties of de novo CAMPs.

Also, we have shown that several CAMPs induce double strand breaks (DSBs) in bacterial chromosomal DNA, resulting in the formation of DNA fragments of the similar length as those produced by gyrase inhibitor levofloxacin. Our results propose

that these DSBs are neither a result ofa direct peptide-DNA interaction nor the consequence of ROS. Instead, the observed DSB formation may be due to the impaired osmoregulatory capacity of *E. coli* cells, resulting in structural changes to the genome that hinder DNA replication.

These findings contribute to a better understanding of the unique characteristics of CAMPs andprovide insights into their mechanisms of action.

OP 18. VIRULENCE OF ENTOMOPATHOGENIC FUNGI ISOLATED FROM BROWN MARMORATED STINK BUG - HALYOMORPHA HALYS (STÅL, 1855) (HETEROPTERA: PENTATOMIDAE) POPULATIONS OF GEORGIA

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The invasion of the pest insect *Halyomorpha halys* (Stål, 1855) (Heteroptera: Pentatomidae) significantly affected the agricultural production of Georgia. While agricultural fields, home plots and windbreaks are treated with thermal fog of wide spectrum chemical pesticides (bifenthrin) to manage insect populations, the diversity of local insects (including beneficial insects) is threatened, the environment is polluted, and the ecological balance is disturbed.

The aim of the research was to study the virulence of entomopathogenic fungi isolated from different populations of *H. halys*. Enzymatic mechanism (chitinase, protease, and lipase) of the entomopathogenic fungi plays a key role in infecting the insect, allowing it to penetrate the body of the insect through the cuticle.

Out of four strains (MB 101, MB 102, MB 103, MB 104) the strain MB 101 with the highest enzymatic activity (chitinase -0, 6057 U/mL, lipase-1,564 U/mL and protease-1, 06 U/mL) causes the highest mortality of *H. halys*. In concentrations of 1x10^6, 1x10^7, 1x10^8 (conidia mL^{-1}) Nymph mortality was 80%, 97%, 99%, and adult mortality is 80%, 93%and 99%, respectively

Such characterization of entomopathogenic fungi lets us select local perspective isolates for the control of pest insects using biologically safe, ecologically friendly ways.

OP 19. IN-VITRO PROPAGATION OF GEORGIAN GRAPE VARIETIES AND THEIR CONSERVATION IN GENE-BANK

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It is known that Georgia has 525 native varieties *(Vitis vinifera* ssp. *sativa DC.)*, which start from the wild grape *Vitis vinifera* ssp. *sylvestris* Gmel. The wild grapevine has an important role in the viticulture to understand the development of the plant, its biodiversity and genetics. The genetics of the wild grapevine has interesting aspetcs for the modern viticulture, beside domestication process, researches show that wild vines have some resistance toward the different pathogens.

The idea of in-vitro micropropagation stands on the plants's ability of totipotency and plasticity. Propagation can be done by various methods under aseptic conditions. Plants adapt the artificial environment, start shoot proliferation, rooting process and rhizogenesis and adapt the ex-vitro environment properly.

Some of the varieties are endangered and in-vitro rapid propagation is a useful tool to achieve the desired results-in-vitro methods are necessary to solve problems of propagation.

Additionally, in-vitro plant micropropagation is a main tool to get virus free plants to support nursery production in Georgia, which is the challenge of modern agriculture.

In this research, several genotypes of grapevines – cultivated varieties and wild compartments - are investigated. Explants for the micro propagation were collected from the Jighaura collection of the Scientific – Research Center of Agriculture. Collection process was done twice- spring and autumn seasons. Explants, in the form of shoots and canes were collected. Canes were put in the conditions, where they started the vegetation process after three to four weeks. The surface of shoots were sterilized with sodium hypochlorite (NaOCl). Then explants were propagated by apical meristem, to get a true to type plants. They were cultured on the different mediums. The main aim was to find a suitable growing medium for explants, which were supplemented with the different concentrations of plant growth regulators. On the suitable mediums plants start to grow and complete the process of shoot proliferation, rhizogenesis, organogenesis and development. Plants were kept in the phytotron, where physical conditions are under the control. After achieving the desired size, they are moved to greenhouse for the adaptation to the ex-vitro environment. For the better acclimatization, different growing substrates are examined.

After the experiment, the optimized protocols for 10 different varieties from Vitis vinifera sativa and Vitis vinifera sylvestris were found, explants were successfully micro propagated and adapted to the ex-vitro conditions. According to the EPPO standards, after checking on pathogens (PCR, ELISA), plants propagated mentioned way can be a pre-basic material for healthy, virus-free material production for the nurseries.

Poster
Presentations

PP 1. SYNTHESIS OF A NOVEL TYPE DIBENZOSUBERENONE-BASED FLUORESCENT DYES FOR CHEMOSENSORY APPLICATIONS

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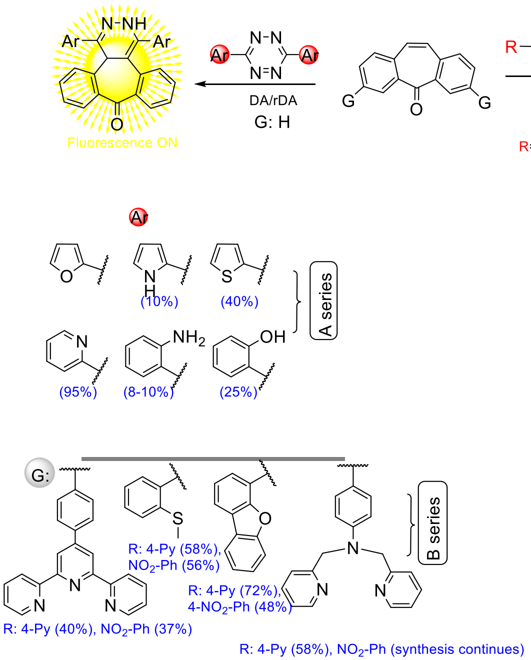
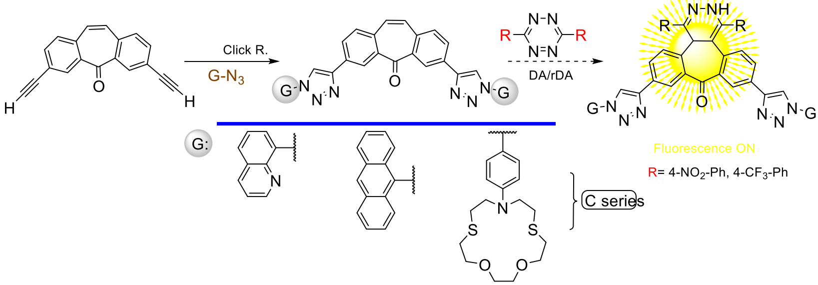
The widespread use of heavy metal ions in the industry results in serious environmental pollution and human health problems, negatively affecting agriculture and destroying natural life. On the other hand, some biologically important metal ions are essential for life [1]. However, the extent of the effects played by the hazardous metal ions on human health depends citically on the amount that is exposed. Therefore, selective, qualitative, and quantitative determination of heavy metal ions *in vitro* and *in vivo* environments at low concentrations is important. Fluorescent molecules, which have been developed as an alternative to classical methods, have long been used in bio-nanotechnology and environmental sciences to develop novel ion- and/or molecule-recognition sensors [2,3]. Dibenzosuberenone and its derivatives exhibit significantly photophysical properties and are widely used in materials chemistry [2,3]. Our research group discovered a new family of dibenzosuberenone-based fluorescent dyes using the Diels-Alder chemistry [2,3].

Result and discussion. In this study, we examined the *inverse* Diels-Alder cycloaddition reactions between various dibenzosuberenone (G=H) or dibenzosuberenones that bear functional groups capable of binding metal ions at 3- and 7-positions and various substituted *s*-tetrazines.

Dibenzosuberenone derivatives **(A** and **B** series**)** were obtained in good yield when the dibenzosuberenone derivate was allowed to react with *s*-tetrazines (1.2 equiv.) [4] in a sealed tube in toluene at 120-180 °C for 24-96 h following the same sequence of [4+2]-Diels-Alder (DA), *retro*-Diels-Alder (*r*DA), and 1,3-prototropic *H* shifting reactions (Scheme 1). For the preparation of the B series starting materials, 3,7-substituted dibenzosuberenone derivatives, were obtained in good yields by the Pd-catalyzed Suzuki coupling reaction of 3,7-dibromo-5*H*-dibenzo[*a*,*d*][7]annulen-5-one with phenyl boronic acids **(**G-$B(OH)_2$**)** in DME/H_2O (v/v: 2/1) in the presence of Na_2CO_3 at 100 °C for 24 hours. The chemical structures of the novel dyes were determined by NMR, IR, and HRMS analyses. The synthesis of the starting materials for the synthesis of the **C** series is in progress (Scheme 2).



Scheme 1. Synthesis of dibenzosuberenone based fluorescent dyes (A and B series).



Scheme 2. Synthesis of dibenzosuberenone based fluorescent dyes (C series).

Conclusion. A new series of dihydropyridazine-dibenzosuberenone derivatives (A and B series) have been designed, and synthesized via *inverse* Diels-Alder cycloaddition reactions in good yields. Structural characterizations of the new dyes have been determined using various spectroscopic techniques and were in agreement with the proposed structures. When the preparation of the relevant starting materials for the synthesis of the C series is completed, the syntheses of the cycloaddition products will begin. The studies continue based on the photophysical, heavy metal, and multi-analyte sensor properties of the synthesized dyes.

Acknowledgments. This study was funded by the Scientific and Technological Research Council of Turkey (TÜBITAK) (Project No. 120R032). We thank TÜBITAK for its support.

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PP 2. ECO-FRIENDLY SYNTHESIS OF SOME 3,3 '-(PHENYLMETHYLENE)BIS(2-PHENYL-1H-INDOLES)

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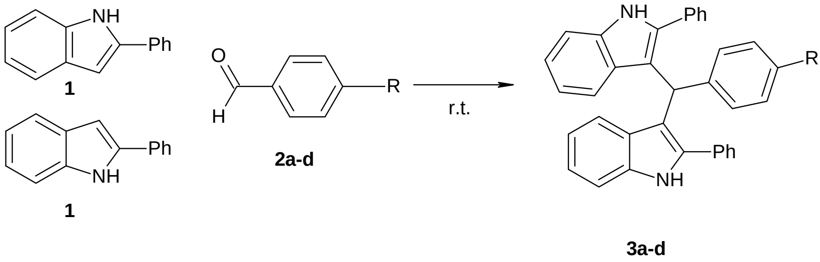
Naturally occurring or synthetic BIMs and its privileged structures are particularly important in pharmaceutical chemistry as they exhibit various pharmacological activities and are important metabolites [1-2]. Different methods have been reported for the preparation of BIMs are known. These methods have their merits in some way as claimed, but, on the other way, they suffer from certain drawbacks; In view of the recent trend in catalytic process which comes under the purview of green chemistry, investigations for new and less hazardous catalysts have become a priority in synthetic organic chemistry [3]. The aim of our research is to study the condensation reactions of 2-phenylindoles and various aromatic aldehydes in the presence of environmentally friendly solvents and catalysts.

2-phenylindole was formed by Fischer indole synthesis from a condensation reaction of a phenylhydrazine and acetophenone in the presence of an acid catalyst in one step. We carried out the synthesis of the target bis-indolyl-phenyl-methane both without solvent, by rubbing the reactants, and in environmentally safe solvents, water and ethanol, at room temperature (Scheme 1).



R a= H; Rb = OH; Rc =Cl; Rd = Br

Scheme 1.

Product isolation from the resulting emulsion-like material have a pure compound. (**Table 1**).

Table 1. Optimization of the reaction conditions for the synthesis of 3a

Entry	Catalyst (mol%)	Solvent	Time (h)	Yield (%)
1	-	EtOH-H_2O (1:1, v-v)	24	trace
2	-	H_2O	24	trace
3*	15	H_2O	72	70
4*	15	EtOH	48	62
5*	15	EtOH-H_2O (1:1, v-v)	24	90
6	-	-	120	95

First, reaction was carried out using H_2O and a mixture of H_2O-EtOH (v:v, 1:1) solvents in the absence of catalyst at room temperature (r.t.), which leads to the formation of product (6) in trace yields (Table 1, entries 1 and 2). The reaction in the presence of SA in H_2O gave 6 in 70% yield for 72 h (Table 1, entry 3). The best result was achieved in the case of a mixture of ethanol: water, 1:1, with the catalytic action of salicylic acid (15 mol %).

The substrate scope of the reaction was successfully established with 2-phenylindole (1) and various aldehydes under the optimized reaction conditions and results are shown in **Table 2.** Substituted benzaldehydes with various functionalities in the phenyl group including -OH, -Cl, and -Br effectively formed the corresponding products (3b-d,) in good isolated yields.

Table 2. Synthesis of BIMs (**3b-d**) catalyzed by SA at room temperature.

Aldehyde	Product	Time, (h)	Yields (%)
-C_6H_5-OH	3b	24	90
-C_6H_5-Cl	3c	48	93
-C_6H_5-Br	3d	48	91

The reaction proceeded with good yield when Compound 1 and 2 were mixed and grounded in a mortar with a pestle at room temperature for 15 min without any solvent. The procedure offers some advantages, but required long reaction time.

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*This project was supported financially by the **Shota Rustaveli National Science Foundation of Georgia** (grant № FR- 21-1456)*

PP 3. BIOCHEMICAL STUDY OF SOME BIOLOGICALLY ACTIVE COMPOUNDS OF EDIBLE OIL

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Georgian red wines made from "Saferavi" grapes contain a particularly large amount of substances that are distinguished by unique properties, because these substances are abundantly present not only in the pulp, but also in the skin of the grape seed. Therefore, we considered it interesting to study the phenolic compounds contained in the cold-pressed oil obtained from the seeds of the "Saperavi" grape variety.

We studied the flavonoids contained in the seed oil of "Saferavi" grape variety. It should be noted that the percentage composition of phenolic compounds contained in it is greater than in other types of grape oils.

The substances contained in the oil were analyzed using a high-sensitivity liquid chromatograph, a Waters HPLC system (Milford, MA, USA) was used in the experiments. Samples were separated on a Waters Nova-Park C-18 analytical column (100 mm, 83.2 mm, 5 µg) with a fluorescence detector (270 nm elongation, 350 nm emission), speed 2.00 cm/min.

As a result of the research, we found that “Saperavi” grape seed oil contains a large amount of phenolic compounds with antioxidant and anti-radical properties: Resveratrol (20.4mg/dm3); Procyanidin (45.3mg/dm3); Catechin (24.1mg/dm3); Epicatechin (10.2mg/dm3). Phenolic compounds have a wide spectrum of action in the human body: anti-inflammatory effect, lowering blood pressure, lowering blood glucose levels. They have the ability to protect the body from the harmful effects of sunlight, radiation; reduce the risk of benign and malignant tumors; It is used for the treatment of oncological diseases of the gastrointestinal tract; Their action has a positive effect on cardiovascular, allergic, hematological and a number of other diseases.

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PP 4. DESIGN, SYNTHESIS, AND SOME TRANSFORMATION OF α-ACYLOXY CARBOXAMIDES

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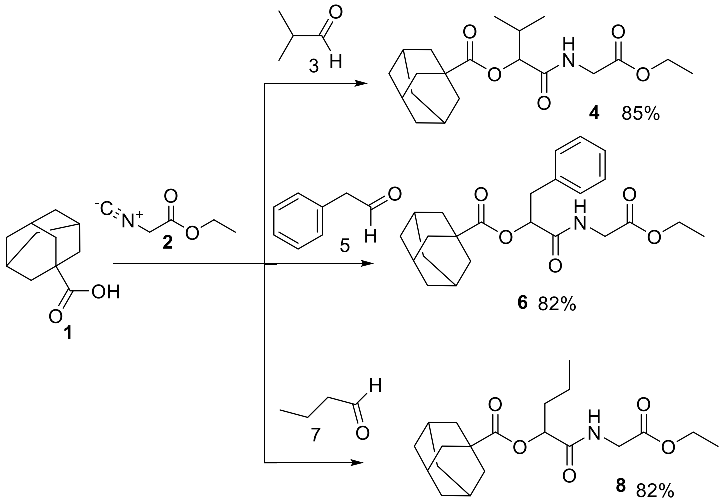
Passerini reaction was the first to represent an isocyanide-based multicomponent reactions (IMCR). The reaction of isocyanides, aldehydes or ketones and carboxylic acids to afford α-acyloxyamides is an isocyanide-based multicomponent reaction. Which was discovered by the chemist Mario Passerini working in Florence in 1921. Passerini reactions are used in production of drug and total syntheses of biologically relevant natural products. Adamantane and derivatives are used in pharmaceutical products for their various medical properties. Adamantane derivatives are specifically linked to the central nervous system and are used to treat Parkinson’s and Alzheimer’s.

This project aims to obtain adamantane containing new derivatives by the Passerini reaction.



The Passerini reaction was conducted by the interaction of 1-adamantane carboxylic acid, aldehydes (isobutyl, phenylacetaldehyde, and butyl aldehyde), and ethyl isocyano acetate in dichloromethane at room temperature. The progress of the reaction was monitored by TLC. After finishing, the reaction mixture was concentrated and the residue was pacificated on the column chromatography ($SiO2$, Hexane/Ethyl acetate, 8/1). The structure of synthesized compounds was established by NMR and IR spectroscopy.

PP 5. USE OF PSEUDOPROTEINS IN THE PRESERVATION OF AGRICULTURAL PRODUCTS

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The increasing interest in edible and biodegradable films for food packaging is becoming more evident every day, as non-degradable materials do much damage to human health and the environment. Today, such methods of storing agricultural products as canning, drying, vacuuming, freezing, and covering with wax or foam have been replaced by an innovative method - covering food products with a thin polymer coating. Such films control the diffusion of water and gases, prevent the colonization of the surface of products with bacteria and other microorganisms, and decrease the content of vitamin C and other important useful components. Monocomponent pseudoprotein biodegradable food coating films are used in this experiment. Polymer alcoholic solutions of different concentrations were prepared, with which samples of apples and carrots were covered by the method of dip-coating. Through the mathematical planning of the experiment, the storage capacity/shelf-life of agricultural products with pseudoprotein food coating was investigated. The water-soluble dry matter has been selected as the research parameter. Temperature, coating materials concentration, and storage time/shelf-life are selected as factors affecting the research parameter. Based on the experiments and visual observation of the three-month preservation of the products, it was revealed that coated samples kept ripening, good natural color and appearance.

PP 6. CONDUCTIVE POLYMER ASSISTED TRANSITION METAL BASED 3D ELECTRODES FOR POTENTIAL APPLICATION IN SUPERCAPACITIVE DEVICES

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To serve the increasing requirements of modern systems, such as hybrid electric vehicles, portable consumer electronics, or large-scale industrial power systems, the efficiency of electrochemical energy storage (EES) devices has to be substantially improved by developing new materials and a better understanding of the fundamental electrochemical processes at the charge storage interface. Due to their promise as electrical energy storage devices for high energy and power applications, electrochemical capacitors, also known as supercapacitors (SC), have drawn significant attention in recent years. [1] Making porous, high surface area transition metal oxide-based composite electrodes (therefore increasing the capacitance) can lead to better performance in supercapacitive devices. However, the poor electrical conductivity of metal oxides (MnO_2 in this case) limits their utilization as electrode materials for supercapacitors.[2,3] This problem can be overcome by creating composite structures with conductive polymers in connection with electrically conductive nanostructured carbon materials such as graphene which is regarded as next-generation electrode material for energy storage and conversion systems due to its unique properties, such as ultrahigh theoretical surface area, superior conductivity, and rich surface chemistry. In this work, we report on the fabrication of conductive polymer-facilitated composite 3D electrodes composed based on manganese oxide and graphene foam. Manganese oxide which serves as charge storage material and carbon flakes were obtained via electroexfoliation in one step electrochemical process applying chronoamperometry. The mixture was characterized by its composition content and magnetic properties. It was mixed with conductive polymer Poly(3,4-ethylene dioxythiophene) (PEDOT) and pasted on top of graphene foam (PDMS-based graphene). The capacitance of this electrode was studied by taking cyclic voltammetry and analyzing non-faradaic response in phosphate buffer solution. The composite with conductive polymer demonstrated increased capacitance compare to bare graphene foam.

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PP 7. FORMIC ACID AS A MODULATOR: ENABLING TEMPLATE-BASED SYNTHESIS OF METAL-ORGANIC FRAMEWORKS

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The achievement of precise control in creating metal-organic frameworks (MOFs) is crucial for ensuring the reproducibility of various physical characteristics, including particle size, shape, crystal structure, porosity, and surface chemistry. To address this, the concept of modulated self-assembly has emerged as an effective approach. This involves incorporating modulator molecules, such as formic acid in this case, into the synthetic mixtures [1]. The primary objective of this article is to present a comprehensive overview of the development of modulated synthesis, with a specific focus on coordination modulation. Initially designed to limit the growth of MOF crystals, this technique has evolved into a method commonly employed to enhance all the previously mentioned physical properties. The physical properties of the MOFs produced through the aforementioned method were assessed using electron microscopy, infrared spectroscopy, and analysis of relative surface area. Based on the obtained results, this article will provide some observations and discuss future perspectives regarding the given area of research.

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PP 8. MODIFICATION OF SILICA NANOPARTICLES WITH FLUORESCENT DYES FOR ENHANCED OPTICAL PROPERTIES AND BIOMEDICAL APPLICATIONS

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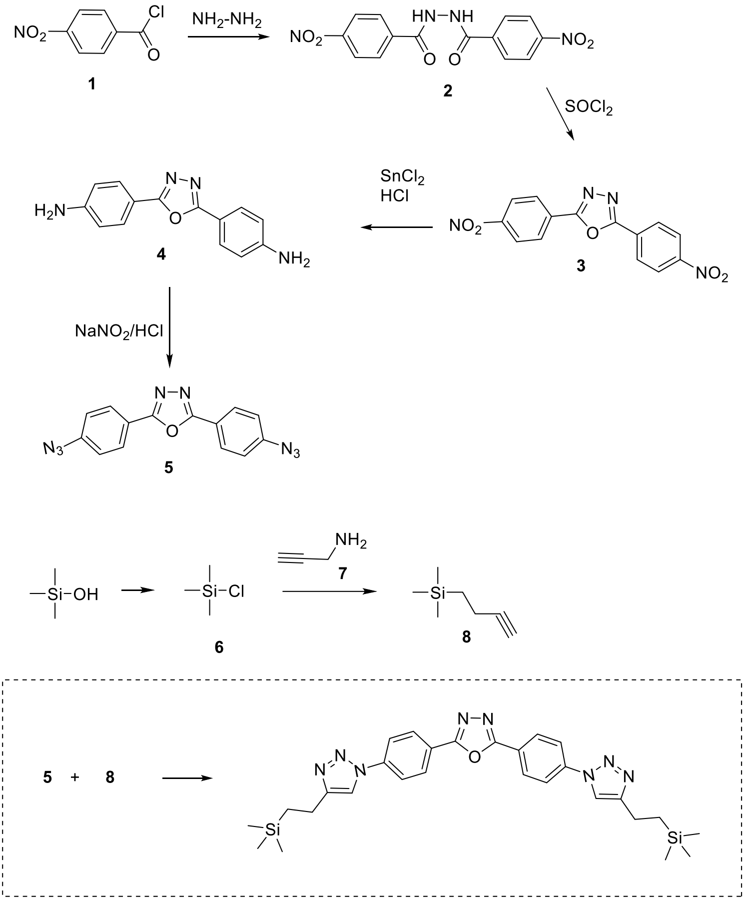
Silica nanoparticles (SNPs) have gained significant attention in various fields, including biomedicine, due to their exceptional physical and chemical properties. In recent years, the modification of SNPs with fluorescent dyes has emerged as a promising approach to impart enhanced optical properties for advanced imaging and sensing applications. This research aims to explore the synthesis and characterization of silica nanoparticles modified with fluorescent dye to develop functional nanomaterials with improved optical properties.

The study involves a comprehensive investigation of the synthesis methods for fabricating silica nanoparticles, the selection of appropriate fluorescent dyes, and the optimization of the modification process to achieve efficient dye incorporation and stability. Various characterization techniques, such as transmission electron microscopy (TEM), and spectroscopic analyses, are employed to assess the morphology, size distribution, and optical properties of the modified SNPs.

Dye preparation was carried by pathway including five steps according to the scheme shown below. The reaction progress was monitored on every step using thin-layer chromatography (TLC) analysis, allowing for the identification of the intermediate and final products. Characterization of the product was performed using various spectroscopic techniques, including nuclear magnetic resonance (NMR) and infrared (IR) spectroscopy.

Furthermore, the research focuses on evaluating the photophysical properties, including fluorescence intensity, quantum yield, and photostability, of the modified silica nanoparticles. The influence of different factors, such as dye concentration, surface functionalization, and nanoparticle size, on the optical performance is investigated. Additionally, the biocompatibility and cellular uptake of the modified SNPs are assessed to determine their potential for biomedical applications, such as bioimaging and targeted drug delivery.



Scheme 1. Dye synthesis and modification of silica nanoparticles.

PP 9. WOOL SURFACE MODIFICATION BY USING DIRECT AZO COUPLING REACTION

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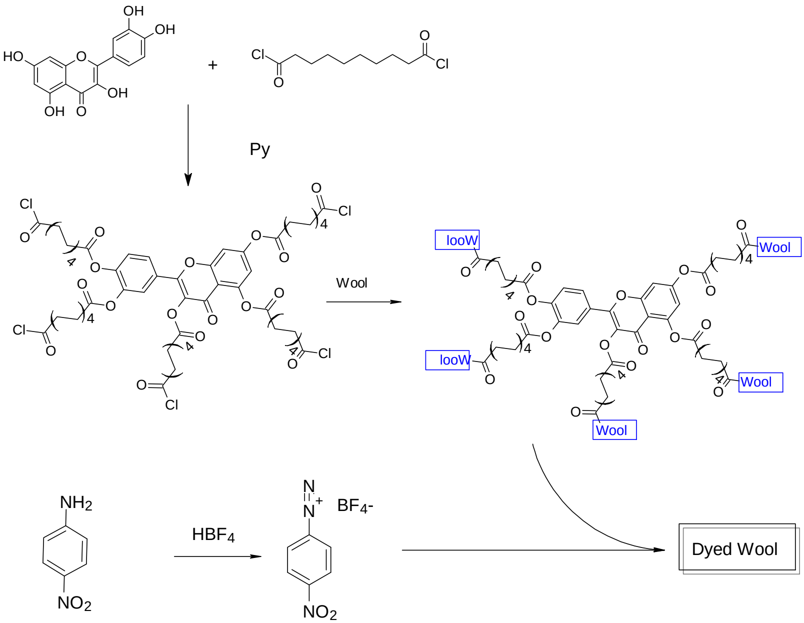
Today it is very interesting to develop the fast chemical conjugation methodology, which will be suitable for different type molecule and giving possibility of the synthesis of large molecules from small ones in a single interaction. Beside of the catalyzed ligand binding and click reactions, direct azo coupling reaction is very important tool for rapid and easy modification of the polymeric matrixes.

Such capacity is important in device fabrication and biomedical applications where it can be highly advantageous to be able to control surface properties independently of the bulk material properties. Nitrogen-containing chemical species – diazo and diazonium functionalities – are emerging as ideal candidates either for direct coupling, or after extrusion of nitrogen under thermal or photochemical conditions, to generate highly reactive species (carbenes, nitrenes, radicals, carbocations) capable of reacting at a surface with covalent bond formation. This digest outlines recent developments – and cautions – in this area. A detailed review of the functionalization of polystyrene and their applications has appeared [1].

On the other side there is a large demand for dyes in paper, textile and clothing industries, the dye wastewater has become one of the main sources of water environment pollution. It has been reported that about 20–40% of dyes cannot be successfully fixed on various materials to be dyed in different technological processes, resulting in a huge amount of dye wastewater up to about 200 billion liters per year. Dyes are non-biodegradable, toxic, carcinogenic, and bioaccumulative, and the discharge of dye wastewater into the environment will pollute the water source and pose a threat to the ecosystem and human health. Hence, the problem of dye pollutants on water resources is widely concerned [2].

The aim of the current research is the obtaining dyed wool material by using non-toxic azo and diazo partners. The synthesis has been carried out according the scheme shown below. First step is the preparation of the quercetin containing active azo partner by the O-acylating of quercetin with decanedioyl dichloride. Next steps involve wool surface modification and direct azo coupling with preliminarily obtained diazo partner from the 4-nitroaniline.



Scheme 1. The direct synthesis of the dyed wool fiber

The obtained dyed wool fiber has good fastness against wet treatment.

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PP 10. CATIONIC POLY(ESTER AMIDE) 8R6 – SYNTHESIS, CHARACTERIZATION AND NANOPARTICLES FORMATION

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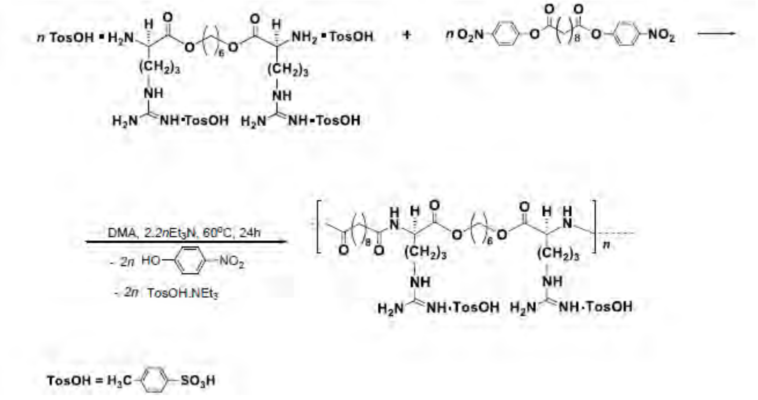
Gene delivery is one of the major challenges for the success of gene therapy based therapeutic strategies, which are the most promising and innovative options for treatment of serious illnesses such as some inherited disorders, some types of cancer, and certain viralinfections. A variety of nucleic acids such as plasmid DNA (pDNA) and small interfering RNA (siRNA) are used as effective therapeutic drugs in gene therapy, vaccination, and tissue regeneration by regulating the relevant gene on (expression) or off (silencing). The main stages of this promising restorative approach are: the protection of the nucleic acid, its penetration into the cell, its transfer inside the nucleus, and for some applications its integration into the genome of thehost cell. Various viral vectors and synthetic transfection agents (e.g. cationic polymers) are beingused to solve the said tasks [1-4]. Cationic polymers are also promising for use in biomedicine as both drug delivery devices and systems (nanocontainers) [5].

Within the framework of the present work we have synthesized cationic poly(ester amide) –8R6 composed of amino acid L-arginine (for incorporating guanidine groups) using activepolycondensation method. The resulting polymer 8R6 was characterized using various techniquesincluding FTIR and ^{1}H NMR spectroscopies.



Scheme 1. Synthesis of cationic poly(ester amide) **8R6** by Solution Active Polycondensation

Biomedical nanoscale dispersed systems were obtained on the basis of synthesized 8R6 by nanoprecipitation/solvent displacement method and the properties were studied by dynamic light scattering (DLS). The mean diameter of the fabricated “cationic” nanoparticles ranges in size from 238 nm to 240 nm and the surface charge (zeta-potential) was up to 5.55 mV, which increases bioavailability into the target cell membranes. Thus, obtained polymeric nanoparticles are promising for biomedical applications in nanotechnology as drug delivery systems.

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PP 11. CELL-SUPPORTING PROPERTIES OF LEUCINE-BASED PSEUDO-PROTEIN (LPPS) FILMS: A STUDY USING RAW264.7 CELLS

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This study explores the potential of biomimetics – leucine-based pseudo-proteins (PPs) in tissue engineering and wound repair. In our research, we examined three artificial PPs: 1L6 (composed of carbonic acid (1), L-leucine (L), and 1,6-hexanediol); 8L6 (composed of L-leucine, 1,6-hexanediol, and sebacic acid) and copolymeric PP (consisting of 70 mol% 1L6 and 30 mol% 8L6). The main aim of our research was to analyze the PPs' ability to support cell growth and study their potential influence on cell physiology.

Experiments were performed on mouse monocyte/macrophage cell line RAW 264.7.

In cells growing on the polymeric substrates several physiological parameters have been assesed: cell migration, actin cytoskeleton distribution, macrophages polarization (according to surface expression of phenotype markers), mitotic index, cell proliferation rate.

The examination of actin cytoskeleton organization using confocal laser microscopy (CLM) has revealed a considerable abundance of focal adhesions, as well as distinct structures associated with cell motility, including filopodia and lamellipodia. These results indicate, that all three PP films have a high affinity towards RAW 264.7 cells.

Obtained data also demonstrated an intensive proliferation of macrophages grown on 8L6 film, as in this case an elevated mitotic index has been detected. From the other side, evaluation of macrophages capability to migrate was relatively decreased in cells grown on 8L6 film, but a notable stimulation of macrophage migration was observed in the case of both: 1L6 and the copolymer films, suggesting their potential in enhancing cellular motility.

As the functional state of macrophages depends on their polarization status [1], another important parameter that we have evaluated, was macrophage polarization (towards pro-inflammatory – M1 or pro-regulatory – M2 state). For this reason we examined the expression levels of two surface markers: CD86 (high expression typical for M1) and CD206 (high expression typical for M2) [1]. Obtained results indicated that PP scaffolds might affect macrophage polarization state. As well as in case of cell motility evaluation, different PPs revealed a dissimilar effect: 1L6 promoted higher expression of CD86; 8L6 – higher expression of CD206, while copolymer (which contains both - 1L6 and 8L6) caused an increased surface expression of both markers, but elevation of CD206 level was more prominent. Generally phenotyping resuts look to be in line with the cell migration data, as more extensive migration is typical for M1 cells and both – migration rate and M1 marker's expression is higher in case of 1L6.

We can summarize, that all three PP films used in our research have revealed good supportive properties towards RAW264.7 cells and also had a certain differential effects on cell physiology, which needs to be studied in more detail.

Supported by Shota Rustaveli National Research Foundation, Project PHDF-22-798.

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PP 12. CELL-SUPPORTING PROPERTIES OF LEUCINE-BASED PSEUDO-PROTEIN (LPPS) FILMS: A STUDY USING PRIMARY MOUSE SKIN FIBROBLASTS

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In the field of the modern experimental biomedicine tissue engineering tasks became more and more essential [1]. In many cases tissues engineering presumes use of different scaffolding materials. A relatively novel group of biomimetics - α-L-amino acids-based biodegradable polymers -pseudo-polymers (PPs), have a good potential to be used for such applications [2]. In our study we have investigated a possibility to use PP films as a scaffolding material for skin regeneration. Three artificial PPs (pseudo-proteins) were used - *1L6* (composed of carbonic acid (1), L-leucine (L) and 1,6-hexanediol), *8L6* (composed of L-leucine, 1,6-hexanediol and sebacic acid) and the *copolymeric* PP – (constituted of 70 mol % of 1L6 and 30 mol % of 8L6). Using primary mouse skin fibroblasts (pMSFs), we have studied how growing on PP films affects cell functional characteristics, such as cell adhesion, cell motility, cell proliferation.

In order to evaluate cell adhesion and cell migration we analyzed actin cytoskeleton organization by confocal laser microscopy, which revealed a high number of both: focal adhesions and well-distinguished motility-associated structures, indicating a high affinity of the PP scaffolds towards pMSFs. To evaluate cell migration and proliferation rate we have made a model of the wound healing process *in vitro* (as described by Liu et al.,2006) [3]: a scratch was made in the confluent monolayer cell culture grown on glass cover slip, or cover slip coated with PP film. After 8 hours of incubation, the level of scratch “closure” in experimental samples (cover slips coated with PP films) was more prominent than in the control (cover slips without films). Finally, we estimated the number of metabolically active cells through MTT assay, which showed an increase in cell metabolic activity in cells grown on PP films compared to the control.

Overall, our data indicates, that all three PP films used in our research, reveal cell motility and cell growth promoting properties towards pMSFs and, subsequently, have a good potential to be used for skin regeneration tasks.

Supported by Shota Rustaveli National Research Foundation, Project PHDF-22-798.

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PP 13. A549 CELLS ARE RESISTANT TO TOPOISOMERASE 1 POISONING

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Topoisomerase I (Top1) poisons can prevent religation of single-strand breaks in DNA by stabilizing covalent enzyme-DNA intermediates. The abundance of these enzyme and its importance in the proper functioning of cell, have made it the target of many scientific studies. Stabilizing of topoisomerase I (Top1) induced single-strand brakes by Top 1 inhibitors is cytotoxic to proliferating cells, as well as malignant tumors. It is well established that lung cancer is a prevalent disease and also is one of the leading causes of mortality, thus it remains a challenge to effectively treat lung cancer. In our research we determined the impact of rubitecan on viability of human lung carcinoma (A549) cells. Rubitecan is an antitumor agent with potent to prevent DNA from unwinding during replication via DNA topoisomerase I (Top1), by this way this compound induces caspase 3-dependent apoptosis in cells and interfere with tumor growth. We studied the formation of 24 kD PARP 1 proteolytic fragment as a marker of caspase 3-dependent apoptosis by western blotting assay in cells treated with different concentrations of rubitecan. Additionally, we preformed MTT assay to measure cellular metabolic activity of cells treated with Top1 inhibitor and validate apoptosis by measuring mitochondria membrane potential using flow cytometry technic. In order to make the study reliable, mitochondria membrane potential measured by flow cytometry and MTT assay were also performed on rhabdomyosarcoma (RD) cells. Our results have indicated a different effect of rubitecan on RD cell line compared to A549 cells, in particular, rubitecan did not effect the viability and metabolic activity of A549 cells. As no apoptotic fragments of PARP-1 have been detected by western blotting assay, it can be concluded that A549 cells are resistant to rubitecan induced apoptotic cell death.

PP 14. EFFECTS OF SUB-INHIBITORY CONCENTRATIONS OF CAMPS ON E.COLI DIVISION RATE: A COMPARISON BETWEEN INCLUSION BODY BEARING AND NON BEARING RECOMBINANT CELLS

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The expansion of antibiotic resistance and the associated infections pose a substantial global health and economic burden. In the face of the problem, Antimicrobial Peptides (AMPs) have been proposed as a viable class of novel antimicrobials, partly due to their various modes of action with non-specific targets, which inherently reduce susceptibility to bacterial resistance evolution. In order to acquire deeper insights into their mechanism of action, one of the approaches employed in our previous study involved monitoring *De Novo* designed FITC-labeled Cationic Antimicrobial Peptides (CAMPs) against RFP-expressing E. coli K12 DH5α. This revealed a particular distribution pattern of peptides, with the FITC signal being predominately localized in inclusion bodies. Bacterial inclusion bodies (IBs), also known as Protein Aggregates (PAs) are insoluble submicron proteinaceous particles (ranging from 50 to 800nm) occurring in bacteria as a result of stress or gene overexpression. In this study, our focus lies in comparing the division rates between IB-bearing and non-bearing recombinant cells of RFP-expressing E. coli K12 DH5α, that were treated with sub-inhibitory levels of FITC-labeled CAMPs – 24L and 24D. Results indicate that bacterial cells, where CAMP accumulated in the IB exhibited an inability to undergo division. However, compared to IB-bearing cells, where no peptide was initially introduced, those IB-bearing cells, that were exposed to the peptide, but did not accumulate it in IB, showed higher division rates. In light of these findings, we may suggest that IB-bearing cells might tend to transition into persister cells, and the presence of sub-inhibitory levels of CAMPs appears to stimulate their exit from this state.

PP 15.

EFFECT OF RESVERATROL ON LIPID-LOADED J774 CELLS

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Non-alcoholic fatty liver disease (NAFLD), is a highly prevalent health condition with limited treatment options. It affects approximately a quarter of the global population. NAFLD is characterized by hepatic triglyceride (TG) accumulation of more than 5%, resulting in steatosis and hepatic inflammation. NAFLD includes a complex spectrum of disorders ranging from simple fatty liver (steatosis) to nonalcoholic steatohepatitis (NASH) and cirrhosis. Calorie restriction has been identified as the primary approach for managing NAFLD, but alternative therapeutic interventions are being explored. Resveratrol, a natural polyphenolic compound, has shown potential in improving various health conditions, including NAFLD, although its mechanism of action remains unclear.

In this study, we investigated the effects of resveratrol on J774 monocyte/macrophage cell line, which serves as a model system for Kupffer cells. The macrophages were exposed to free fatty acids (oleic and palmitoleic acid mixture) and subsequently treated with low doses of resveratrol (5mM and 10mM) for a duration of three hours.

Initially, our experiments focused on determining whether these concentrations of resveratrol exhibited any pro-apoptotic effects on this particular cell line. Results has shown no significant changes in inducing apoptosis while treated with resveratrol. Furthermore, we decided to investigate the effect of resveratrol on J774 cells migration. Resveratrol, is known to cause an activation of SIRT1 in certain types of cells [1]. From the other side, it has been shown, that SIRT1 induces lamellipodium formation and promotes cell migration [2,3]. Based on the abovementioned it was logical to investigate whether resveratrol will affect cells motility. Following treatment with free fatty acids, cells exhibited an increased migration activity. The application of resveratrol resulted in an additional enhancement of migration activity in J774 cells. This data is in line with the results shown by others regarding the effect of SIRT1 activators on cell motility [3].

It is known that under pathological conditions, macrophages polarize to various phenotypes, mainly M1 (pro-inflammatory) and M2 (anti-inflammatory) [4]. Polarization changes the ability of macrophages to migrate [5], so considering our results regarding the effect of resveratrol on cell motility, we decided to check macrophage polarization by looking at surface antigens: M1 marker - CD86 and M2 marker - CD206. Unexpectedly, both concentrations of resveratrol induced a significant increase in CD86 surface expression in FFA-treated cells. This resveratrol-induced increase of CD86 surface expression doesn’t agree with our data on cell migration, as increased migration is typical for M2 cells, while a high level of CD86 - for M1 [4,5]. To evaluate macrophages polarization in more detail and find an explanation for the discrepancy in our data, a study of cytokine profile in control and resveratrol-treated J774 cells will be performed at the next stage of the research.

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PP 16. EFFECTS OF HEAVY METALS ON POD ENZYME ACTIVITY IN CORN AND BEAN ROOTS: A NATIVE ELECTROPHORESIS STUDY

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Environmental contamination with heavy metals is a global environmental, agricultural and health issue due to their highly toxic and carcinogenic nature. Compounds that contains heavy metals are deposited on the surface of the soil and water and are absorbed by plants. Influence of these compounds, even at very low concentration, can cause many morphological, physiological, and biochemical changes, this disturbs the normal functioning in plants via excessive generation of reactive oxygen species (ROS), a condition known as oxidative stress leading to an imbalance in the redox system of the plant. The aim of the presented work is to study the impact of heavy metals, specifically lead (Pb) and arsenic (As), on the activity of peroxidase (POD) enzymes in the roots of corn and beans. The plants were cultivated in a hydroponic system and subsequently exposed to varying concentrations of Pb and As. The activity of POD enzymes was assessed to determine the physiological response of the plants to heavy metal contamination. Native electrophoresis was utilized to visually observe changes in isoperoxidase activities.

The results demonstrate an alteration in POD enzyme activity in both corn and bean roots upon exposure to Pb and As. Increasing concentrations of heavy metals, in most cases, led to a dose-dependent decrease in POD enzyme activity, suggesting a negative impact on the antioxidant defense system. Native electrophoresis analysis revealed distinct changes in the patterns and intensity of isoperoxidase bands, indicating alterations in POD isoforms.

These findings highlight the sensitivity of corn and bean roots to heavy metal contamination and provide valuable insights into the physiological responses of plants to Pb and As stress. Understanding the effects of heavy metals on POD enzyme activity is crucial for developing strategies to mitigate the harmful consequences of environmental pollution on plant growth and productivity

PP 17. NANOCONTAINERS ON THE BASE OF FUNCTIONAL MACROCYCLE

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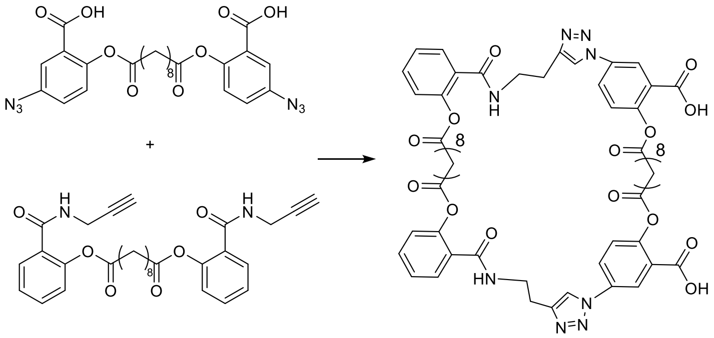
Nowadays, click chemistry - cycloaddition between alkynes and azides to form 1,2,3-triazoles is the most popular reaction due to its reliability, specificity, and biocompatibility [1]. On the other hand, new types of nanocarrier systems based on macroheterocycles containing non-toxic metabolic fragments are of great interest for the development of both drug and oxygen carrier systems [2].

For the click reaction, we had two target products obtained by reacting salicylic acid derivatives with sebacoyl chloride.

The azide was synthesized through 5-ASA, which was obtained by reducing the nitration product of salicylic acid.

The alkyne component was obtained by the reaction between propargyl amine and the ester derived from salicylic acid and sebacoyl chloride.



Synthesis of macrocycle via click reaction

We synthesize macrocycles by using click chemistry methods. Obtained nontoxic metabolic fragment, such 5-Aminosalicilic acid, macrocycle are characterized enriched properties in comparison of carbon analogues Increased complex formation ability and less toxicity.

Therefore, the product should have a wide range of uses in bio-organic chemistry, pharmacology and medicine.

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PP 18. SYNTHESIS OF AZO DYES WITH BIOLOGICAL ACTIVE MOIETIES

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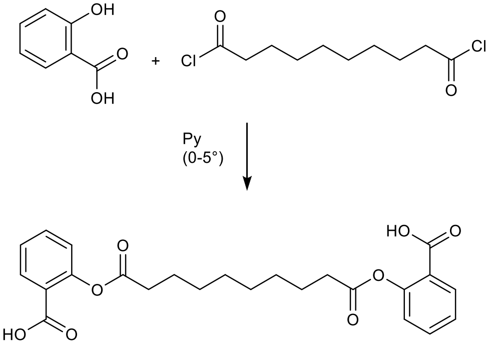
Dyes have a long history of application and are still an important component in our daily lives. Due to the wide range of applications, the removal and decontamination of azo dyes from wastewater is one of the particular challenges [1]. One of the innovative approaches is the synthesis of such azo dyes whose metabolism-generated compounds are non-toxic and degradable.

5-aminosalicylic acid (5-ASA) is widely used for the treatment of inflammatory bowel disease (IBD), including ulcerative colitis and Crohn's disease. It is also useful for the treatment of colorectal cancer [2].

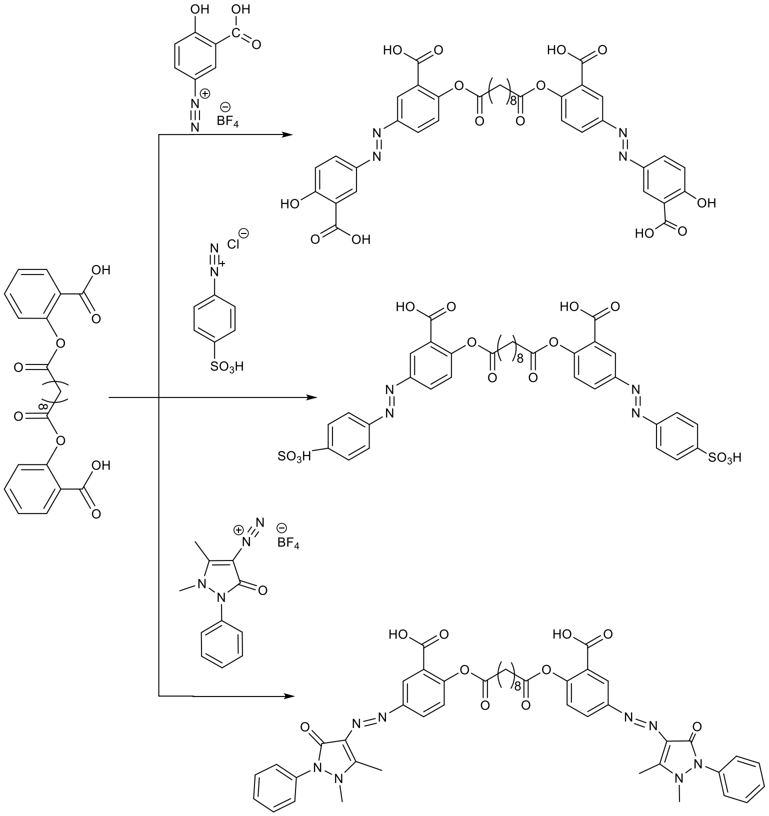
4-Aminoantipyrine was utilized as key intermediate for the synthesis of pyrazolone derivatives bearing biologically active moieties. which is used for the protection against oxidative stress as well as prophylactic of some diseases including cancer, and these are important directions in medical applications [3].

Therefore, we synthesis Azo dyes containing non-toxic metabolic fragments for a drug delivery system.

The synthesis has been carried out according to the scheme:



Scheme 1. Synthesis of key intermediate diester



Scheme 2. Synthesis of azo dyes

The new representatives of nontoxic moieties based azo dyes were successfully synthesized for the first time. Which is expected that will show low immunogenicity that are of interest for numerous biomedical applications.

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PP 19. IN SILICO GENOME ASSEMBLY AND COMPARATIVE GENOMICS OF *VITIS VINIFERA* L

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The precise molecular mechanisms underlying the domestication of grapevine (*Vitis vinifera* L.) is still not fully understood. According to many researchers, the South Caucasus, where Georgia is located, and adjacent areas are the geographic regions where grapevines were most likely first domesticated. Over the recent years, next-generation sequencing (NGS) of plastid genomes has emerged as a powerful and progressively effective tool for plant phylogenetics and evolution. To uncover the biological profile of the grapevine domestication process, a comprehensive investigation should encompass both the cultivated varieties (*Vitis vinifera* subsp. *vinifera*) and their wild ancestors (*Vitis vinifera* subsp. *sylvestris*) across all potential sites of their distribution and domestication. The main goals of the presented research were as follows: 1) Assessment of the genetic diversity of wild grapevines from Europe through complete chloroplast DNA Illumina Sequencing; 2) In silico assembly and annotation of the sequenced plastid genomes of wild grapevines from France; 3) Comparative genomics of a wide range of *Vitis vinifera* L. chloroplast genomes. In the frame of the conducted research, the plastid genomes of wild grapevines from France were subjected to NGS. After the assembly of sequence reads, the total length and haplotypes of the analyzed plastid genomes were defined. For the each analyzed genomes a total of 131 genes (protein-coding, tRNA, and rRNA genes) were annotated. The comparative genomics approaches were used to evaluate the phylogenetic relationships among different *Vitis vinifera* L. chloroplast genomes.

This work was supported by Shota Rustaveli National Science Foundation of Georgia (SRNSFG), Grant number # FR-19-14378

PP 20. QUERCETIN CONTAINING NEW AZO DYES

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Dyes have always been important throughout the history and they have more applications than ever now. Organic dyes contain chromophores that absorb and emit light, allowing them to be used in various fields like solar cells, textiles, sensors, optoelectronic devices, and biomedical imaging.

Azo dyes are among the most numerous classes of dyes. They account for most of the dye chemical production capacity and their relevance still is growing up. They perform an important position in the influence of the dyeing and printmaking industries. Azo dyes account for more than nine million tonnes (70% of dye market) of global manufacturing needs [1]. The removal of 4,500,000 tonnes of dyes and/or deteriorated products each year is a socio-economic and environmental problem because of their carcinogenic and mutagenic risk [2]. Azo dyes belong to the most harmful types of manmade dyes produced in cloth manufacturing effluents because of their chemical structures, which contain -N=N- linkage and forms primary aromatic amines after metabolizes. They seem to be highly permanent in the aquatic ecosystem [3].

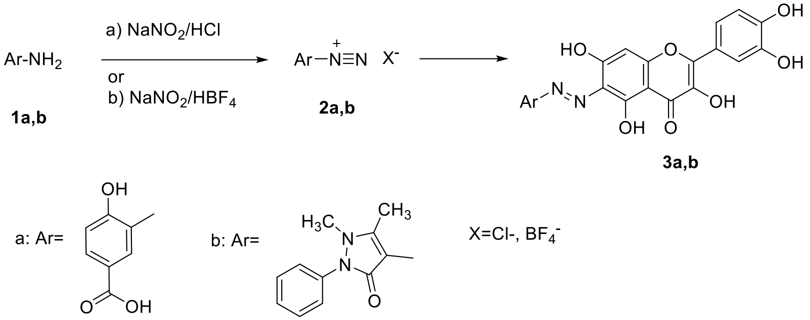
Hence, the synthesis of azo dyes by the application of eco-friendly, non-toxic compounds is very important. Therefore, the main goal of our research is the synthesis of new azo dyes using quercetin as an azo partner and 5-aminosalicylic acid or 4-aminoatipirine as a diazo partner.

Quercetin belongs to the flavonoid's natural dyes and has well-known antioxidant and anti-inflammatory properties. On the other side, there are a numerous number of the scientific papers, describing very important biological properties of 5-aminosalicylic acid [4, 5] as well as 4-aminoantipyrine [6,7].

The synthesis been performed according the following scheme.

First step involves diazotization reaction of starting primary amines 5-aminosalicylic acid (**1a**) or 4-aminoantipyrine (**1b**). Diazotization of **1a** have been carried out by sodium nitrite solution in the presence of hydrochloric acid or tetrafluoro boric acid. The best result has been obtained in the last case due to formation diazonium salt in the stabilized solid state, while $NaNO_2$/HCl mixture is preferable for diazotization of

1b. The next step is azo coupling, which have been carried out in the alkali media and the formed target azo dyes have been isolated from acidified reaction media.



Scheme 1. Synthesis of new quercetin containing azo dyes

The reaction execution has been monitored by TLC. Obtained dyes have been recrystallized and the purity has been established by TLC. The optical properties of the dyes have also studied by UV-vis spectrometry.

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PP 21. MODIFICATION OF THE KEY STAGE OF THE SYNTHESIS OF FLUORESCENT DYE 10-N-NONYLACRIDINE ORANGE

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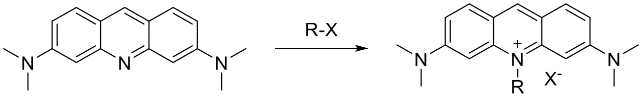
Cardiolipin is an essential lipid, present in the inner bacterial membrane. As it had been shown, increased level of Cardiolipin (CL) may cause bacterial resistance to some antibiotics, like daptomycin [1]. Hence, this phospholipid may serve as a target for some novel antimicrobial agents. Despite fluorescent dye 10-N-nonylacridine orange (NAO) was considered CL-specific probe, it has been shown that it, also, forms complexes with other negatively charged phospholipids in the bacterial membrane [2]. Considering importance of Cardiolipin as a novel target for antibiotics and its role as an apoptosis marker in mitochondria [3], we intent to visualize it exclusively.

For this aim, our main goal is the modification of NAO's structure, as well as it's synthetic methodology. We, also, focus on study of alkyl chain length's and counter ion character's influence on dyeing performance of alkylated AO. Synthesis of primary alkyl halide is one of the key stages in the multistep synthetic pathway of alkylated-AO itself [4].



where R= *n*-Alkyl, X= Br, Cl

Hence, in the ongoing work we focused on the synthesis of Nonyl bromide and studied modifications of the synthetic method.

There are several ways for synthesis of alkyl bromides. Most easy and common way uses HBr, but this reaction is reversible and results in low yield. We worked on increasing the yield while using relatively cheap and available reagents.

$$1.\ R{-}OH + HBr \xrightarrow{H_2SO_4} R{-}Br + H_2O$$

$$2.\ R{-}OH + KBr + H_2SO_4 \longrightarrow R{-}Br + NaHSO_4 + H_2O$$

$$3.\ R{-}OH + PBr_3 \xrightarrow{\text{toluene}} R{-}Br + H_3PO_3$$

$$R = C_9H_{19}{-}$$

Experimental results are present in the following table:

No	Halogenating agent	Time	Temperature	Yield
1	HBr	5 hours	140-150°C	23%
2	KBr	5 hours	160°C	7%
3	PBr_3	3 hours	100°C	37%

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PP 22. ANTIFUNGAL AND ANTIOXIDANT POTENTIAL OF HIGHER BASIDIOMYCETES MUSHROOMS

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Medicinal mushrooms (MMs) mainly belong to the class of higher Basidiomycetes. Numerous mushroom species are abundantly rich in bioactive compounds, and therefore, they comprise a wide range of biological activities. It has been proven that biological activity of mushrooms is directly related to antioxidant activity which is often correlated with high content of phenolic compounds and flavonoids in mushrooms. In recent years, the search of antioxidant and antifungal agents of natural origin become a challenge.

Among twenty-three higher basidiomycetes mushroom species, *Sch. commune* 64 demonstrated highest inhibition rates against pathogenic fungi *A. niger, B. cinerea, F. oxysporum,* and *G. bidwellii* and showed 35.7 %, 6.5 %, 50.4 %, and 66.0 % of growth inhibition, respectively. Moreover, antifungal and free radical scavenging activity where evaluated in hot water, ethanol (80 %) and ethyl acetate extracts from submerged mycelial biomass and culture liquids of *Sch. commune* 64. It was determined that, extracts obtained in the presence of mandarin juice production waste (MJPW) which was used as a mushroom growth substrate in submerged cultivation conditions, inhibited more effectively *B. cinerea, F. oxysporum* and *G. bidwelii* grow. The content of phenolic compounds in the extracts obtained from the biomass and culture liquid of *Sch. commune* 64 grown on MJPW (ranged from 0.87 GAE/g to 2.38 GAE/g) was several times higher than the extracts obtained from the biomass and culture liquid grown on the synthetic (glycerol contained) nutrient medium (ranged from 0.21 GAE/g to 0.88 GAE/g). It was shown that total phenolic content in the ethyl acetate extracts was significantly high (1.97–2.38 GAE/g, and 0.88– 0.79 GAE/g, respectively), as well as the amount of total flavonoids (1.53–1.91 QE/g, and 21.2–27.2 QE/g) to compare to water and ethanol extracts. Highest free radical scavenging activities were revealed by high concentrations 5, 10, and 15 mg/ml used and demonstrate 27–69 %, 53–79 %, and 68–79 %, respectively. The IC_{50} values, were generally low for the extracts, ranging from 1.9 mg/ml to 6.7 mg/ml. All the samples displayed a positive correlation between their concentration (0.05–15.0 mg/ml) and DPPH radical scavenging activity. From present study, it is confirmed that cultural conditions, growth substrates and content of nutrient growth medium have a significant influence on the biological activity of mushrooms. Based on the results obtained, it can be assumed that *Sch. commune* has promising antifungal and antioxidant potential, and it can be recommended as a promising producer of bioactive compounds.

Acknowledgements. We appreciate the support from the Shota Rustaveli National Science Foundation of Georgia (Grant FR-19-3719).

PP 23. THE EFFECT OF PARP INHIBITION ON RUBITECAN INDUCED GAMMA-H2AX FOCI FORMATION IN A549 CELLS

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Many different endogenous or exogenous agents can cause DNA damage. DNA double-strand breaks (DSBs) are the most dangerous and cytotoxic DNA lesions. Gamma-H2AX (γ-H2AX) is the phosphorylated form of histone H2AX which can be used as a sensitive biomarker for DSBs. In present study, we evaluated DNA damage in A549 cells (adenocarcinomic human alveolar basal epithelial cells) which were treated with rubitecan, topoisomerase I inhibitor (prevents DNA from unwinding during replication via DNA topoisomerase I) and olaparib, PARP inhibitor (inhibits poly(ADP-ribose) polymerase, thereby blocking the repair of single-strand DNA breaks). In order to estimate DSBs, we quantitatively analyze γ-H2AX fluorescent foci in treated and control A549 cells. Results have indicated 2.34 fold increase of DSBs in cells treated with rubitecan and 1.8 fold increase in cells treated with olaparib, compared to control samples. Interestingly, combination of both inhibitors results in lower number of gamma-H2AX (6.61 foci per cell) compared to rubitecan alone treated cells (7.53 foci per cell). From this results in can be concluded that PARP inhibition attenuates DSB formation in rubitecan treated A549 cells.

PP 24. EVALUATION OF TELOMERIC DNA FRAGMENTATION IN A549 CELLS EXPOSED TO TOPOISOMERASE I AND PARP INHIBITORS

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Telomeric DNA damage destabilizes the human genome, leading to cell growth arrest or death. For this reason, telomeres have been recognized as attractive anticancer therapeutic targets. Hence, a knowledge of the susceptibility of these chromosomal regions to breakage is of general interest. In the present study, we estimated the effects of topoisomerase I poison (rubitecan) and PARP inhibitor (olaparib) on telomeric and genomic DNA fragmentation in A549 cells, using the DNA-halo FISH technique. Topoisomerase I (Top1) poisons are widely acknowledged cytotoxic anticancer agents, that transform topoisomerase-induced transient breaks into permanent breaks, by stabilizing intermediate cleavage complexes. Top1 poisons generate single-strand breaks, which are converted to double-strand breaks when colliding with replication and transcription machinery. Conversely, PARP inhibitors target DNA repair mechanisms and allow the accumulation of single-stand breaks. The results obtained in our study indicate that rubitecan causes significant genomic and telomeric DNA fragmentation in A549 cells. PARP inhibition in cells treated with rubitecan moderately reduces telomeric DNA damage, however, it shows no effect on genomic DNA fragmentation. Based on these findings, we propose that PARP inhibition attenuates the effect of rubitecan on telomeric DNA damage. On the other hand, no significant effect of PARP inhibition on genomic DNA damage could be explained by the involvement of different repair pathways in genomic and telomeric DNA damage responses.

PP 25. L-CARNITINE AS AN INHIBITORY MOLECULE OF ESTROGEN-DEPENDENT TRANSCRIPTIONAL REGULATION OF METABOLISM

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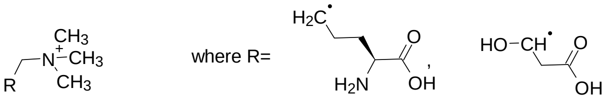
L-Carnitine is known as a transporter molecule of fatty acids in mitochondria, where β-oxidation of lipids takes place [1]. L-Carnitine is widely used as a nutritional supplement during various slimming diets [2].

We have studied the effect of L-carnitine and hormone 17β-estradiol on an *in vitro* model of non-alcoholic fatty liver disease - lipid-loaded cell culture of hepatocytes (Hepa1-6). The level of intracellular lipids was measured after 3h treatment with either carnitine, or estradiol or a combination of these two compounds. According to the obtained results, either L-carnitine or 17β-estradiol caused an activation of fat metabolism, leading to a decrease in cell-stored lipids, but the same compounds added in a combination induced an opposite effect leading to an increase in the intracellular lipids.

We hypothesized, that a possible explanation for the abovementioned results might be following: L-carnitine interferes with the estrogen-dependent transcriptional regulation of metabolism due to its molecular design, which shares the structure of trimethylated lysine [3]:



Kme3 *L-Carnitine*

Therefore, L-carnitine might act as a competitive inhibitor of lysine-specific demethylases.

To check our theory experimentally, after the lipid-loaded Hepa 1_6 cells were treated for 3 hours with 17β-estradiol and L-carnitine individually or in combination, the total level of Histone3 Lysine4 trimethylation (H3K4me3) was evaluated by intracellular staining with monoclonal antibodies against H3K4me3. Fluorescence detection was performed by flow cytometry (Accuri C6, BD). According to the obtained results, an increase in the total level of H3K4me3 has been detected in cells treated with the combination of L-carnitine and 17β-estradiol, while there was no such increase when the compounds were added individually. These data support our theory, as the detected increase in the total level of H3K4me3 can be explained by a decrease of lysine-specific demethylases activity due to the competitive inhibition by L-carnitine.

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PP 26. BIODEGRADABLE NANOPARTICLES BASED ON PSEUDO-PROTEINS FOR COSMETIC APPLICATION

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Nanotechnology has the potential to create innovations in many fields of medicine and cosmetics. Polymer-based nanoparticles (NPs) are of high interest for numerous applications in medicine, including targeted drugs to a considerable potential for treatment of many human diseases [1, 2]. Nowadays, cosmetic formulations incorporating nanotechnology are a relatively new but very promising area of research [3].

For constructing drug delivery systems for medicine and cosmetics biodegradable polymers such as poly(ester amide)s and poly(ester urea)s are promising. Especially attractive are the naturally occurring α-amino acid-based poly(ester amide)s and poly(ester urea)s which are also mentioned as “pseudo-proteins” due to the composition similar to proteins. The NPs prepared from these polymers are suitable for practical applications in medicine and cosmetics since they are non-toxic, highly biocompatible and have the ability to safely be cleared from the body after the fulfilment of their function due to their degradability [4, 5].

The main goal of the present study was the preparation of biodegradable NPs on the basis of above-mentioned pseudo-proteins using the nanoprecipitation method and investigation of the influence of polymer concentration and nature of organic solvents during the nanoprecipitation process on the formation of NPs. Two pseudo-proteins on the basis of α-amino acid leucine – the poly(ester amide) **8L6** and poly(ester urea) **1L6** as well as two organic solvents – ethanol and isopropanol were used in this research.

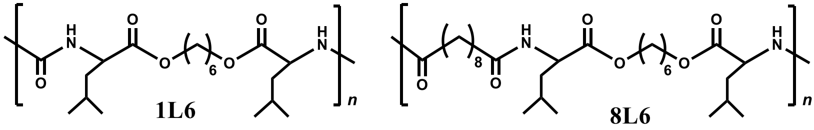

Figure 1. Chemical structures of the pseudo-proteins used for preparing NPs.

NPs were successfully prepared on the basis of both pseudo-proteins. The obtained NPs were characterized by size (average diameter) and size distribution (polydispersity index) using DLS technique. The obtained results showed that the average diameter of NPs in case of using the pseudo-protein **8L6** varied within 85.9 – 397.4 nm depending on the polymer concentration and organic solvent used during the preparation whereas for **1L6-**based NPs the size varied within 124.9 – 272.9 nm. The obtained NPs were stable for storing at low temperature and did not significantly change their parameters over time. Based on the obtained results we can conclude that the elaborated pseudo-protein NPs have potential for application in medicine and cosmetics as drug delivery systems.

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