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Биологический факультет

III Межфакультетская студенческая научно-практическая конференция «Life Sciences in the 21st Century: Looking into the Future»

22-23 января 2020 г., Москва, МГУ

МАТЕРИАЛЫ

Life Sciences in the 21st Century: Looking into the Future

III Межфакультетская студенческая научно-практическая конференция

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22-23 января 2020 г. в МГУ состоялась III Межфакультетская студенческая научно-практическая конференция «Life Sciences in the 21st Century: Looking into the Future» (на английском языке), организованная кафедрой английского языка для естественных факультетов факультета иностранных языков и регионоведения МГУ имени М.В.Ломоносова совместно с биологическим факультетом и при активном участии еще четырех естественнонаучных факультетов университета – почвоведения, фундаментальной физико-химической инженерии, биотехнологического и фундаментальной медицины. На конференции было сделано 109 научных докладов, охватывающих широкий спектр направлений исследований в биологии и смежных науках, начиная от классических зоологических и ботанических наблюдений до использующих самые современные методические подходы экспериментов.

CONTENTS:

Foreword

On 22 - 23 January 2020, the 3rd annual student conference *Life Sciences in the 21st Century: Looking into the Future* took place at the Faculty of Biology of Lomonosov Moscow State University. The conference was organized and conducted by the Department of English for Natural Sciences of the Faculty of Foreign Languages and Area Studies in collaboration with the Faculty of Biology and with active participation of a number of other MSU faculties, namely those of Soil Science, Fundamental Medicine, Biotechnology, and Fundamental Physical and Chemical Engineering.

The conference brought together about 160 participants. The organizing committee received 128 submissions, 109 presentations were made by students from the 5 science faculties mentioned above. The plenary session encompassed 6 topics as diverse as microplastic pollution, the resistance of fungal communities from desert soils to the impact of ionizing radiation, the Bayesian phylogenetic approach to the investigation of enterovirus A71 genotype A reintroduction into circulation, plant programmed cell death, multi-walled carbon nanotubes and nanodiamonds degradation in human macrophages, and the magnetic compass of birds and amphibians.

The work of the conference proceeded in the following sections:

- General biology
- Biochemistry and molecular biology
- Genetics, embryology, histology
- Bioengineering and biophysics
- Physiology and neurobiology
- Ecology

The forum provided young life science researchers with a much-needed opportunity to discuss the results of their work with the peers and seniors, to exchange views and ideas on key issues in focused subject areas and to enhance the existing interdisciplinary, interdepartmental and interfaculty research network in Moscow University. With English being the only working language of the conference, its crucial pragmatic objective consisted in closely imitating the authentic format of professional communication at international scientific conferences, thus testing the adequacy of the students' operational knowledge of English as the global language of science and building their self-confidence.

It is not for nothing that the conference title emphasized its focus on the future: in their presentations, the new generation of life scientists most convincingly demonstrated to their proud teachers and all those present their vast scientific potential. From the plethora of wide-ranging conference materials, however, the present volume only contains

abstracts of 6 plenary and 13 sectional papers whose authors scored the most points for their English (from 92 to 100).

The work of the conference was covered in the newspaper *Moscow University*, 2020, №2 (February), p. 6.

In conclusion, on behalf of the conference organizing committee, I would like to thank many people, students and professors, who have provided help, support and advice during the conference.

Professor Lydia Polubichenko
Dr. habil. in Philology
Head of the Department of English for Natural Sciences
Faculty of Foreign Languages and Area Studies

2019 Student Conference Life Sciences in the 21st Century: Looking into the Future

Programme

January 22

<table>
<tr><td>Plenary session 10.00-13.00</td><td colspan="4">Afternoon session 14.00-19.00</td></tr>
<tr><td>Conference opening address and welcome speech
Lydia Polubichenko, Head of the Department of English for Sciences, Professor of the Faculty of Foreign Languages and Area Studies
A.V.Kitashov, Vice Dean of the Faculty of Biology</td><td colspan="4">Session 1. General biology
Session 2. Biochemistry and molecular biolo
Session 3. Biophysics, bioengineering, biote
Session 4. Physiology and neurobiology
Session 6. Ecology</td></tr>
<tr><td>Plenary presentations
Sergei V. Ogurtsov, Faculty of Biology
Magnetic compass of birds and amphibians (Магнитный компас птиц и амфибий)
Ekaterina Tarasova, Faculty of Biology
Multi-walled carbon nanotubes and nanodiamonds degradation in human macrophages (Деградация многостенных углеродных нанотрубок и наноалмазов в макрофагах человека)
Olesya Ilina, Faculty of Biology
Microplastic pollution problem: do modern humans live in a plastic cloud? (Загрязнение окружающей среды микропластиком: современный человек живет в пластиковом облаке?)
Margarita Kriuchkova, Faculty of Soil Science</td><td>Subsession 1.1 General biology
L.Shevyrdyaeva
M.Popova</td><td>Subsession 1.2 General biology
L.Frolova
A.Foursova</td><td>Subsession 1.3 General biology, Session 6
Ecology
O.Kozlova
E.Kozharskaya</td><td></td></tr>
</table>

Astrobiological aspect of the resistance of fungal communities from desert soils to the impact of the ionizing radiation (Астробиологический аспект устойчивости грибных сообществ пустынных почв к воздействию ионизирующей радиации) **Yulia Vakulenko**, Faculty of Biology Investigation of Enterovirus A71 genotype A reintroduction into circulation using Bayesian phylogenetic approach (Исследование повторного введения генотипа А энтеровируса 71 в циркуляцию с помощью Байесовских филогенетических методов) **Tatiana Doronina**, Faculty of Biology Plant programmed cell death (Программируемая клеточная гибель растений)				
Room M1	Room 3A	Room 498Д	Room 426	

January 23

Morning session 10.00-14.00				
Session 2. Biochemistry and molecular biology Session 3. Biophysics, bioengineering, biotechnology Session 4. Physiology and neurobiology Session 5. Genetics, histology, embryology				
Subsession 2.2 Biochemistry and molecular biology L.Polubichenko O.Egorova	Subsession 3.2 Biophysics, bioengineering, biotechnology N.Glinskaya L.Shevyrdyaeva	Subsession 3.3 Biophysics, bioengineering, biotechnology S.Agadzhanyan M.Popova	Subsession 4.2 Physiology and neurobiology T.Cherezova A.Foursova	Session 5 Genetics, histology, embryology O.Kozlova V.Ignatenko

			A.Ziyatdinova	
Room 519	Room 461	Room 389	Room 462	Room 557

January 22
Afternoon session 14.00-19.00
Subsession 1.1 General biology
Moderators: L.Shevyrdyaeva, M.Popova
Room 3A

	Name	Name	Faculty, department	Title of paper in English	Ti
1	Коржавина Оксана, Никитин Михаил, Иваненко Вячеслав	Oksana Korzhavina, Mikhail Nikitin, Viacheslav Ivanenko	Biology, Invertebrate zoology	Phylogeny and phylogeography of a complex of endoparasitic microcrustaceans causing Multiple Purple Spots Syndrome in the Caribbean Sea fan	Ф эн ра ф мс
2	Кузнецов Пётр	Petr Kuznetsov	Biology, Invertebrate zoology	The Morphology and Microscopic Anatomy of the Deep-Sea Echiurid Protobonellia zenkevitchi Murina, 1976	M ан Pr
3	Лысова Майя Валерьевна	Maiya Lysova	Biology, Higher Plants	Morphological variability and phylogenetic relationships of Crimean and Caucasian members of Lotus section Dorycnium	O фи се Ка
4	Милашенко Екатерина Николаевна	Ekaterina Milashenko	Biology, Virology	Occurrence of poorly studied arbovirus infections in Astrakhan Region	A ма A
5	Салтыкова Виктория Алексеевна	Viktoriia Saltykova	Biology, Microbiology	Antimicrobial activity of the novel planctomycete from the family Pirellulaceae	A но Pi
6	Сёмина Ирина Павловна	Irina Semina	Biology, Vertebrate Zoology	Acoustic, morphological and genetic differentiation of chaffinches (Fringilla coelebs) in the contact zone of Crimean and Caucasian subspecies.	A ге (F кр

7	Терентьева Дарья Александровна	Daria Terenteva	Biology	Taste preferences in golden mbuna Melanochromis auratus.	Вк ме
8	Тропаревская Софья Михайловна	Sofia Troparevskia	Biology, Vertebrate Zoology	Home range structure and daily activity of european bison (Bison bonasus L., 1758) females.	Ст ак (Е
9	Чекин Михаил	Mikhail Chekin	Soil Science, Soil erosion and conservation	Determination of the number and morphological diversity of bacteriophages in the soils of Russia	Оп мо ба Ро
10	Юзефович Александр Павлович	Alexander Yuzefovich	Biology, Vertebrate Zoology	Taxonomy of the Old World leaf-nosed bats (Hipposideros and related genera), with special attention to taxonomically complicated species groups of the Indochinese fauna	Сп (Н вн гр

January 22
Afternoon session 14.00-19.00
Subsession 1.2 General biology
Moderators: A.Foursova, L.Frolova
Room 498Д

	Name	Name	Faculty, department	Title of paper in English	T
1	Блохина Елизавета Андреевна	Elizaveta Blokhina	Biology, Anthropology	Anthropologic and aesthetic face analysis based on the first impression of men's and women's appearance	A п м
2	Борисова Елена	Elena Borisova	Biology, Anthropology	New data on facial reconstruction: Nasal area	Н с
3	Васильева Александра	Aleksandra Vasileva	Biology, Anthropology	Associations of catechol-O-methyl transferase gene polymorphism (COMT) with morphofunctional indicators in Russian and Transnistrian students	A С м с
4	Дмитриев Георгий Владимирович	Georgy Dmitriev	Biology, Mycology and Algology	Analysis of orchid mycoheterotrophy by different methods.	К с

5	Ерохина Ксения	Kseniia Erokhina	Soil Science, Soil Biology	Microbiological Characteristics Of The Black Solder Fly (Hermetia Illucens L.) Biocompost	
6	Кейси Алекс	Aleks Keisi	Biology, Mycology and Algology	Methods of detection amphibian chytridiomycosis (Batrachochytrium spp) in collections and natural populations of Russia	
7	Кунаева Галина Сергеевна	Galina Kunaeva	Biology, Evolutionary biology	Morphology, classification and lineage of sea urchins of the suborder Urechinina (Echinoidea: Holasteroida) of the Mesozoic and Cenozoic border of the Mangyshlak peninsula	
8	Никитенко Екатерина Дмитриевна	Ekaterina Nikitenko	Biology, Invertebrate zoology	Morphology and ultrastructure of spicules Onchidoris muricata (O.F.Muller,1776) (Mollusca, Nudibranchia)	
9	Севастьянов Никита	Nikita Sevastianov	Biology, Evolutionary biology	The rates of evolution of grasshopper song (Orthoptera, Acrididae, Gomphocerinae)	

January 22
Afternoon session 14.00-19.00
Subsession 1.3 General biology, Session 6 Ecology
Moderators: O.Kozlova, E.Kozharskaya
Room 426

	Name	Name	Faculty, department	Title of paper in English	
1	Вузман Елена	Elena Vuzman	Biology, Ecology and Plant Geography	The flora of the Luven'ga Archipelago, the Kandalaksha Gulf, the White Sea	
2	Гроздов Ярослав Алексеевич	Iaroslav Grozdov	Soil Science, Soil Geography	Influence on Belogorye nature reserve soils from Stary Oskol-Gubkinsky Industrial Agglomeration	
3	Доценко Константин Павлович	Konstantin Dotsenko	Soil Science, Soil Biology	Yeasts associations with Lasius flavus ants	

4	Дубонос Анна	Anna Dubonos	Biotechnology	Search for fungi and bacteria that decompose industrial polymeric materials	П п
5	Манвелян Кристина	Kristina Manvelyan	Biology, General Ecology and Hydrobiology	Dependence of the toxic effect on cultivation conditions of Artemia salina L.	З у L
6	Мищанчук Ксения	Ksenia Mishchanchuk		Patterns of distribution of vegetation of Kunashir island	З р
7	Сефилиан Анна	Anna Sefilian	Soil Science	Soft-sediment deformations in ecosystems of West Siberia, Russia. Scientific interpretation of natural art.	Д э и
8	Сидорова Таисия Алексевна	Taisiya Sidorova	Soil Science, Soil biology	Comparison of the properties of mycobiota of buried soils of different genesis and different burial duration in the floodplain	С п р
9	Суханов Артемий Юрьевич	Artemiy Sukhanov	Biotechnology	Gene search for rhodopsin-like proteins in Arctic permafrost deposits	П м
10	Тиморшина Светлана Наильевна	Svetlana Timorshina	Biology, Microbiology	Exoproteases of micromycetes with keratinolytic activity	Э к

January 22
Afternoon session 14.00-19.00
Subsession 2.1 Biochemistry and molecular biology
Moderators: T.Cherezova, A.Ziyatdinova
Room 519

	Name	Name	Faculty, department	Title of paper in English	Tit
1	Азимов Карим Алиевич	Karim Asimov	Biology, Molecular Biology	The gene editing in cell models of epidermolysis bullosa as a part of development therapies for patients with genetic disorders.	Ге мо ра ге
2	Басс Дина	Dina Bass	Biology, Biochemistry	D-amino acid dehydrogenase (dadA) from Pseudomonas aeruginosa as an	Де Ps

				instrument for controlling intracellular pyruvate concentration	дл ко
3	Бизяев Никита	Nikita Bizyaev	Biology, Biochemistry	Effect of secondary structure of 3'-untranslated region on activation of translation termination by PABP	Вл не тер
4	Вьюшков Владимир Сергеевич	Vladimir Viushkov	Biology, Molecular Biology	Cell model for in vivo investigation of MYC and IGH loci dynamics	Кл ло
5	Зеленская Маргарита Львовна	Margarita Zelenskaia	Biology, Biochemistry	Preparation of monoclonal IgG type antibodies against the Tn-antigen, suitable for immunodiagnosis of carcinomas and tumor immunotherapy	По ти им им
6	Изюмов Роман	Roman Iziumov	Biology, Genetics	Development of a test system for the diagnosis of somatic mutations in the PIK3CA gene for breast cancer, validation of the test system on the material of FFPE blocks.	Ра со ра си
7	Новицкая Елизавета Кирилловна		Biology, Genetics	Influence of fragments of neuropeptide nesfatin-1 on transcription expression targets in rats.	Вл не эк
8	Рябкова Наталья Сергеевна	Natalia Riabkova	Biology, Biochemistry	Development of a method for purification of Pregnancy-associated glycoproteins (PAGs)	Ра гл бе
9	Сулейманов Руслан	Ruslan Suleimanov	Biology, Microbiology	Targeted isolation of novel, biotechnologically relevant strains of methanotrophic bacteria	На би шт
10	Черных Михаил	Mikhail Chernykh	Biology, Bioengineering	Structural basis of interaction between Nav channels and alpha-scorpion toxins	Ст на ка

January 22
Afternoon session 14.00-19.00
Subsession 3.1 Biophysics, bioengineering, biotechnology
Moderators: N.Glinskaya, V.Ignatenko
Room 389

	Name	Name	Faculty, department	Title of paper in English	Tit
1	Андреева Татьяна	Tatiana Andreeva	Biology, Bioengineering	Effect of linker structure and magnesium ions on conformation of nucleosomal DNA	Вл ио ну
2	Габдуллин Ришат	Rishat Gabdullin	Fundamental Physical and Chemical Engineering, Applied Mathematics and Physics	Synthesis and study of the structure, physical properties and biocompatibility of polymers based on fullerene C_{60}.	Си фи по
3	Грицева Алиса Павловна	Alisa Gritseva	Fundamental physical and chemical engineering	A comparative study of the kinetics of the death of photogenerated current carriers in powders and thin CdS films by microwave photoconductivity.	Ср ги то ме
4	Зверев Павел	Pavel Zverev	Fundamental Physical and Chemical Engineering	Nanocalorimeter of high temporal resolution for the study of functional materials	На раз фу
5	Киприна Анастасия	Anastasiia Kiprina	Biology, Bioengineering	CD45 CAR T cells for the treatment of blood cancers	Т к ан ле
6	Кулакова Анна Вячеславовна	Anna Kulakova	Fundamental Physical and Chemical Engineering	Investigation of zeolite ZSM-5 samples by small angle X-ray scattering	Ис ме ре
7	Нартов Кирилл	Kirill Nartov	Fundamental Physical and Chemical Engineering	X-ray diffractometry method for studying the structure of $La_{1-x}Sr_xFeO_3$ and $Ca_{1-y}Pr_yMnO_3$ perovskites.	Ме из $_x$Sr
8	Пермякова Алена	Alena Permyakova	Biology, Bioengineering	Ph-sensor properties of the fluorescent protein from the coral polyp Dendronephthya sp.	Рн бе De

9	Филалова Эмилия	Emiliya Filalova	Fundamental Physical and Chemical Engineering	Development of methods for applying Pt-catalyst layers for low-temperature fuel cells: dosing blade	Раз кат тог

January 22
Afternoon session 14.00-19.00
Subsession 4.1 Physiology and neurobiology
Moderators: S.Agadzhanyan, E.Mikheeva
Room 462

	Name	Name	Faculty, department	Title of paper in English	Tit
1	Аббосов Шухрат Анварович	Shukhrat Abbosov	Fundamental Medicine, Urology and Andrology	Treatment of men with stricture of bulbar urethra	Вы стр
2	Абрамова Анна Александровна	Anna Abramova	Fundamental Medicine	MRI post-processing: a useful tool to improve detection of subtle forms of focal cortical dysplasias	По улу кор
3	Анна Канцерова	Anna Kantserova	Biology, Higher nervous activity	Long latency components of auditory evoked potentials of human midbrain in propofol anesthesia and clear consciousness: case report	Дл вы зар чел кли
4	Балакирева Алина Игоревна	Alina Balakireva	Fundamental Medicine, Internal Medicine	Preeclampsia, HELLP –syndrome after kidney transplantation.	Пр пер
5	Ильина Ксения Александровна	Kseniia Ilina	Fundamental Medicine	«Covert cognition» among patients with chronic disorders of consciousness: how to diagnose it?	Ди соз нар
6	Квак Александр	Alexander Kvak	Biotechnology	Registration of local field potentials (LFP) of the deep brain structures in	Рег пот

				experimental animals in free behavior in vivo	мо сво
7	Морозова Марина Витальевна	Marina Morozova	Biotechnology	Brain Rhythms and Motor dysfunction in Rat's Model of Parkinson's Disease	Ос дви экс кры
8	Сафонова Елизавета Дмитриевна	Elizaveta Safonova	Fundamental Medicine	Therapy circuit selection of chronic lymphocytic leukemia in patients with deletion (17p13.1) (p53)	Вы лим (17
9	Сулейманова Алина	Alina Suleimanova	Biology, Higher nervous activity	Behaviour in mice selected for high and low brain weight: genetic differences in reaction to immobilization stress	По раз на
10	Шляпкина О.С., Мершина Е.А., Синицын В.Е.	Shliapkina O.S., Mershina E.A., Sinitsyn V.E.	Fundamental Medicine, Radiology and Radiotherapy	Results of diffusion-weighted and dynamic contrast-enhanced MRI as biomarkers for evaluation of breast cancer response to neoadjuvant chemotherapy	Рез MR уси эфф хим

January 23
Morning session 10.00-14.00
Subsession 2.2 Biochemistry and molecular biology

Moderators: L.Polubichenko, O.Egorova

Room 519

	Name	Name	Faculty, department	Title of paper in English
1	Борисова Надежда Ивановна	Nadezhda Borisova	Biotechnology	Influence of amino acid substitutions i "black" and "grey" clusters of calmodulin on its functional properties
2	Волков Дмитрий	Dmitrii Volkov	Fundamental Medicine, Pharmaceutics	Switchable CARs for oncological diseases therapy based on the barnase-barstar complex.

3	Воскобойников Александр Андреевич, Самченко Александр Анатольевич	Voskoboinikov A.A., Samchenko A.A.	Biotechnology	Comparative analysis of genomic sequences of extremophiles and mesophiles
4	Гайнова Кристина	Kristina Gainova	Biology, Molecular biology	Study of methyl-DNA binding properties of transcription factor Kaisc
5	Зобнина Дарья	Dariya Zobnina	Biotechnology	Directed mutagenesis of sterol side chain degradation genes of strain Mycolicibacterium neoaurum NRRL I 3805
6	Литвинова Екатерина Андреевна	Ekaterina Litvinova	Biology, Molecular biology	Role of Lam proteins in the transport o sterols in yeasts Saccharomyces Cerevisia
7	Маркин Роман Валерьевич	Roman Markin	Biotechnology	Amyloid aggregation of the carbonic anhydrase mutant forms
8	Пирогов Сергей	Sergei Pirogov	Biology, Molecular biology	Post-transcriptional regulation of rRN genes with R2 transposon insertions b Piwi protein
9	Смирнова Ксения	Kseniia Smirnova	Biology, Molecular biology	The study of the mechanisms of Mtln functioning
10	Солдатова Юлия	Yulia Soldatova	Biology, Molecular biology	Search for regulatory elements causing non-canonical transcription terminatio at the locus mod(mdg4) in Drosophila melanogaster
11	Хозов Андрей	Andrey Khozov	Biology, Microbiology	Search for new genes responsible for transport of amino acids into Escherichia coli cells
12	Чепурных Юлия	Iuliia Chepurnykh	Biology, Biochemistry	Investigation of the mechanisms of Parkinson's disease cell model based o differentiated derivatives of IPSc.

13	Шлык Валерия	Valeriya Shlyk	Biology, Molecular biology	High-throughput screening for inhibitors of protein biosynthesis in bacterial cells

January 23
Morning session 10.00-14.00
Subsession 3.2 Biophysics, bioengineering, biotechnology
Moderators: N.Glinskaya, L.Shevyrdyaeva
Room 461

	Name	Name	Faculty, department	Title of paper in English
1	Горшков Егор	Egor Gorshkov	Fundamental Physical and Chemical Engineering	Synthesis and structure of terbium and dysprosium complexes with diethyl-dithiocarbamate and 2, 2’-bipyridine
2	Еременко Иван Викторович	Ivan Eremenko	Fundamental Physical and Chemical Engineering	RAFT polymerization of protonated diallylammonium monomers for obtaining polymers with high antimicrobial activity
3	Корякин Дмитрий	Dmitry Koryakin	Fundamental Physical and Chemical Engineering	Elaboration of methods for applying platinum-containing catalyst layers for low-temperature fuel cells
4	Костина Евгения Андреевна	Evgeniya Kostina	Fundamental Physical and Chemical Engineering	Analysis of the photochemical activity of nanoparticles based on fullerene-chlorin dyads and surfactant
5	Лизунова Наталья Владимировна	Natalia Lizunova	Biology, Human physiology and animals	Reparative potential of tissue-engineered construct with human iPSCs neural progeny in conditions of brain trauma in mice
6	Мальцева Анастасия Игоревна	Anastasia Maltseva	Biology, Microbiology	Antioxidant enzyme defense systems of anoxygenic phototrophic bacteria

7	Марьина Александра	Alexandra Marina	Fundamental Physical and Chemical Engineering	Optimization of the active mass composition of the positive electrodes based on vanadium pentoxide nanowires
8	Мелкова Ангелина	Angelina Melkova	Fundamental Physical and Chemical Engineering	Solid solution of hydrogen Ca0.3SiO2.3-H2
9	Охезин Егор	Egor Okhezin	Biology, Virology	Effect of temperature in the helicase activity of NS3 protein of mammalian tick-borne flaviviruses
10	Соловьева Анастасия Юрьевна	Anastasiia Solovieva	Biology, Biochemistry	Study of reaction mechanism of thiocyanate dehydrogenase by stationary kinetics methods
11	Сорин Евгений	Eugene Sorin	Fundamental Physical and Chemical Engineering	Investigation of a nanocomposite photocurable system based on bisphenol A dicyanate with ferrocene catalyst for further use in 3D printing
12	Чеснокова Дарьяна	Dariana Chesnokova	Biology, Bioengineering	Microsphere-based scaffolds from poly(3-hydroxybutyrate) for 3D cell growth

January 23
Morning session 10.00-14.00
Subsession 3.3 Biophysics, bioengineering, biotechnology
Moderators: S.Agadzhanyan, M.Popova
Room 389

	Name	Name	Faculty, department	Title of paper in English
1	Клименко Татьяна	Tatiana Klimenko	Biotechnology	Application of The Minimum Inhibitory Concentration (MIC) for adequate treatment of the patient.
2	Козлова Анастасия	Anastasiia Kozlova	Biology, Bioengineering	Role of C-terminal domains of yeast FACT complex in nucleosome unfolding

3	Кольжецов Николай	Nick Kolzhetsov	Biotechnology	Genome sequencing and analysis of the new isolate Sporosarcina sp.
4	Кусяпкулова Альбина Бахромовна	Albina Kusyapkulova	Fundamental Physical and Chemical Engineering	New heterogeneous catalytic systems for isomerization of endo-tetrahydrodiciclopentadiene
5	Миловская Ирина Георгиевна	Irina Milovskaya	Biology, Biochemistry	Extracellular matrix-coated calcium phosphate ceramics for bone repair
6	Одинцова Алина Сергеевна, Минайчев В.В., Теплова П.О., Фадеева И.С., Акатов В.С.	Alina Odintsova, V.V. Minaychev, P.O. Teplova, I.S. Fadeeva, V.S. Akatov	Biotechnology	Characterization of nano-sized hydroxyapatite-based paste materials' biointegration
7	Пикалов Евгений	Evgeny Pikalov	Fundamental Physical and Chemical Engineering	Synthesis and research of physical and chemical properties of liquid crystalline compounds based on 2,3,4-tris (alkyloxy) benzenesulfonic acid
8	Русанова Мария	Maria Rusanova	Biology, Microbiology	Mass spectrometry-based peptidome profiling of Helicobacter cinaedi
9	Смирнов Иван	Ivan Smirnov	Biotechnology	Synthesis and characterization of nanoparticles based on lignin-like polymers
10	Федорова Ульяна	Uliana Fedorova	Biology, Bioengineering	A single-molecule study of carboxymethilcellulose using atomic force microscopy

11	Юнусова Валентина Алексеевна	Valentina Iunusova	Biology, Biochemistry	Membrane voltage indicator based on prestin electromotile protein and FusionRed red fluorescent protein

January 23
Morning session 10.00-14.00
Subsession 4.2 Physiology and neurobiology
Moderators: T.Cherezova, A.Foursova, A.Ziyatdinova
Room 462

	Name	Name	Faculty, department	Title of paper in English
1	Амбарян Сюне	Syune Ambaryan	Biology, Immunology	The role of TNF cytokines in murine cutaneous wound healing
2	Бобков Александр Петрович	Alexander Bobkov	Fundamental Medicine, Internal Medicine	New Horizons of Angiotensin-converting Enzyme Exploitation in Clinical Practice
3	Волынникова Евгения Николаевна	Evgeniia Volynnikova	Biology, Human and Animal Physiology	Effects of high-salt diet on development of renovascular hypertension: sex differences
4	Галков Максим Дмитриевич	Maksim Galkov	Biology, Human and Animal Physiology	Protective effects of new PAR1 agonist peptide in the mouse model of photothrombosis-induced brain ischemia
5	Головичева Виктория	Victoria Golovicheva	Biotechnology	Research of the neuroprotective properties of extracellular vesicles of mesenchymal stromal cells in a model of traumatic brain injury
6	Гречухина Катерина, Чеботарева Наталья	Katerina Grechukhina, Natalya Chebotaryova	Fundamental medicine, Internal diseases	The clinical influence of biomarkers of nephrotoxicity induced by cisplatinum and antiangiogenic antitumor compounds

7	Докукин Никита	Nikita Dokukin	Biotechnology	Analysis of synaptic stimulation influence on hippocampus metabolic activity.
8	Казанская Лидия Сергеевна	Lidiya Kazanskaya	Biology, Neurobiology	Comparison of c-fos and Arc genes expression patterns in mouse brain after contextual associative memory formation and retrieval
9	Кочкина Ольга	Olga Kochkina	Fundamental Medicine, Obstetrics and Gynecology	Placenta-associated pregnancy complications. Parallels with family history.
10	Новикова Алена Александровна	Alena Novikova	Biology, Bioorganic chemistry	The influence of donor memory T cells on the recipient's repertoire at the early stage of recovery after allogeneic hematopoietic stem cell transplantation
11	Сазонова Маргарита Михайловна	Margarita Sazonova	Biology, Neurobiology	The study of the effect of phase-locked acoustic stimulation on sleep parameters.
12	Самусевич Анастасия	Anastasia Samusevich	Fundamental Medicine, Obstetrics and Gynecology	Atrophic endometrium. Why is it so dangerous?
13	Тимошина Юлия	Julia Timoshina	Biology, Human and Animal Physiology	Mechanisms of physiological action of ouabain (on model of mania-like behaviour in C57Black/6 mice)
14	Чурсанова Екатерина Николаевна	Ekaterina Chursanova	Biology, Immunology	regulation of neutrophil and eosinophil recruitment in aspergillus fumigatus-induced allergic airway inflammation.

January 23
Morning session 10.00-14.00
Session 5 Genetics, histology, embryology

Moderators: O.Kozlova, V.Ignatenko
Room 557

	Name	Name	Faculty, department	Title of paper in English
1	Баглай Александра Ивановна	Alexandra Baglay	Biology	Changes in platelet activity by T-cadherin's ligands: low-density lipoprotein and adiponectin
2	Борисов Павел	Pavel Borisov	Biology, Embryology	Trochoblast cilia formation in embryos of Lymnaea stagnalis Linnaeus, 1758 (Gastropoda: Lymnaeidae) with different levels of intracellular serotonin
3	Гладышева-Азгари Мария	Maria Gladysheva-Azgari	Biology, Genetics	Analysis of somatic mosaicism and chromosomal pathology in brain cells in mental disorders
4	Евтушенко Надежда Алексеевна	Nadezhda Evtushenko	Biology, Embryology	Modeling of epidermolysis bullosa simplex in the HaCaT cell line
5	Зайцева Анастасия	Anastasia Zaitseva	Biology, Genetics	The role of polymorphic variants of genes of folate cycle enzymes in the pathogenesis of migraine.
6	Королева Анастасия	Anastasia Koroleva	Biology, Virology	Development of the candidate influenza A vaccine based on TMV-antigen bioconjugation
7	Машкин Михаил Александрович	Mikhail Mashkin	Biology, Embryology	Effects of reactive oxygen species on spermatogenesis and sperm physiology
8	Новикова Вероника Владимировна	Veronika Novikova	Biotechnology	Analysis of influence of metabolic pathways modification on drug resistance of acute myeloid leukemia cells in multicellular aggregates.
9	Парадня Евгения	Evgeniya Paradniya	Biology, Genetics	Genetic diversity of sugar beet Beta vulgaris L

10	Петрова Дарья Александровна	Daria Petrova	Biology, Cell Biology and Histology	The role of the nucleolar protein SURF6 in the meiotic maturation of GV oocytes of mouse
11	Плотникова Мария	Maria Plotnikova	Biology, Genetics	Human T-cell receptor gene repertoires in neuropsychiatric disorders
12	Подсвирова Светлана	Svetlana Podsvirova	Biology, Immunology	Effects of TLR3, TLR4 agonists and the combination of TLR4 with checkpoint inhibitors on tumor microenvironment in B16F0 murine melanoma model
13	Сизова Мария Александровна	Mariia Sizova	Biology, Human and Animal Physiology	Influence of BNIP3, Bcl-2 family protein, on different cell death patterns
14	Хан Алексей Владимирович	Alexey Khan	Biology, Genetics	Development of reporter system for parallel analysis of transcription factor activity

Plenary presentations

Using Bayesian Phylogenetics for Investigation of Enterovirus 71 Genotype A Reintroduction into Circulation in China

Исследование повторного введения генотипа А энтеровируса 71 в циркуляцию с помощью Байесовских филогенетических методов

Yulya Vakulenko

Faculty of Biology

EV-A71 is one of the main causative agents of hand, foot, and mouth disease (HFMD) and may cause severe neurological complications such as brainstem encephalitis, aseptic meningitis and acute flaccid paralysis. A massive EV-A71 epidemic that involved over a million cases occurred in China in 2008-2011. Although a vast majority of cases in China were associated with subgenotype C4, several isolates belonged to genotype A (GtA) which had allegedly been extinct since 1972. The identification of GtA isolates in that epidemic suggests a reintroduction of the archive strain into circulation.

The regression analysis of genetic distances and isolation years (TempEst software) of the EV-A71 dataset comprising all genotypes failed to reveal abnormalities in the Chinese GtA sequences due to the low resolution of classical phylogenetic methods. However, the substitution rate inferred for GtA upon regression analysis was compatible with aberrant evolutionary history. The bayesian statistical phylogenetic analysis that uses isolation year data yielded a well-resolved phylogenetic tree that allowed detecting suspicious evolutionary events among EV-A71 GtA isolates. The branch rates leading to Chinese sequences differed by over three standard deviations from the mean substitution rate for EV-A71, which suggests an artificial introduction into circulation. The manual nucleotide-level analysis was used to further explore the virus spread pattern after the introduction into circulation. Upon introduction, the virus diverged into two lineages. One of them was detected in Beijing in 2009. The other lineage spread all over Southeast China; and its typical feature was an N282D substitution, which is very rare among other EV-A71 sequences (33 sequences out of 7026) and supports a common origin for this group. Upon reintroduction, the virus accumulated up to seven

substitutions in the VP1 encoding gene. Most of the accumulated mutations were non-synonymous and were located within the capsid's canyon or at its rims and regions that participate in binding with receptors and antibodies and commonly harbour immune escape mutations. This observation could be compatible with readaptation of a cell-culture-adapted virus to circulation among humans.

The case of EV-A71 GtA reintroduction indicates that laboratory escapes remain a realistic threat. It adds to the history of well-known releases of the H1N1 influenza virus in 1977 and smallpox in the UK, as well as many less famous release events.

Plant programmed cell death

Программируемая клеточная гибель растений

Tatiana Doronina

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Keywords: *Programmed cell death, apoptosis, antipodal cells*

Programmed cell death (PCD) is involved in the life of any multicellular organism. Redundant, functionally inactive, infected with viruses, old or defective cells are removed from the body in the process of PCD. So the death of a few cells to save the whole organism has an altruistic meaning. The most common variant of PCD in animals is apoptosis. Apoptosis is characterized by condensation of chromatin, blebs formation and cell fragmentation into apoptotic bodies absorbed by other cells.

Plant PCD has not been studied as much as animal PCD. One of the classifications of plant PCD is based on morphological features. Following this classification, cases of plant PCD can be divided into two groups. The first group (vacuolar cell death) comprises cases of cell lysis due to tonoplast rupture and degradation of organelles. The second group includes cases where lysis was not observed (programmed necrosis or apoptotic-like PCD). It is characterized by strong condensation of chromatin and protoplast shrinkage, DNA laddering and cytochrome c release from mitochondria to cytoplasm. Plants do not have «classic» apoptosis with the formation of apoptotic bodies and activation of caspases - cysteine proteases with aspartate substrate specificity which play a crucial role in animal apoptosis.

A good example of plant PCD is the death of the antipodal cells of the wheat embryo sac. Antipodal cells are cells with polytene chromosomes. At the early stages of grain development, they feed and protect the endosperm coenocyte, which is the main tissue of the grain. During cellularization of endosperm, PCD of antipodal cells is started. Individual polytene chromosomes of the nuclei of antipodal cells come together, chromatin condensation and DNA fragmentation occur, the nucleoli break up into separate fragments, the nucleoli and fragments of chromatin can be extruded from the cells into the endosperm cytoplasm, cytochrome c is released from mitochondria. Some features of PCD, such as chromatin condensation, DNA fragmentation, and the release

of cytochrome c, are signs of apoptosis-like cell death. Other features, such as segregation of nucleoli and nucleoli and chromatin extrusion, are very unusual and can be explained by the specificity of antipodal cells - cells with polytene chromosomes.

To sum up, the task of further research in this field would be accumulation of knowledge, and investigation into PCD of unusual objects, such as antipodal cells, can help to solve this problem.

Microplastic pollution problem: do modern humans live in a plastic cloud?

Загрязнение окружающей среды микропластиком: современный человек живет в пластиковом облаке?

Olesya Ilyina

Faculty of Biology

The problem of plastic pollution in natural habitats has been studied and discussed for the last four decades, since the global polymer production industry was established. A major concern of environmental ecologists consists in plastic litter accumulation by marine ecosystems, mainly observed inside subtropical gyres of ocean currents and in the highly polluted Mediterranean Sea. At the same time, wide areas of the World Ocean away from accumulation zones demonstrate much lower buoyant plastic density than the so-called Ocean Garbage Patches. However, plastic particles of under 5 mm, called microplastics, are recognized to be a ubiquitous pollutant found in the most remote areas of the World Ocean such as the Arctic and the Antarctic seas, in surface water as well as in the deep water bottom sediments.

Plastic pollutants are known to produce multiple mechanically harmful and toxic effects on living organisms as well as to be concentrated in trophic chains, e.g. ascending from invertebrate planktonic organisms up to fish, marine mammals and birds. It causes an even greater concern about human health risks assessment, related to consuming seafood coming from highly polluted areas.

In order to develop a proper experiment design we analyzed a set of samples, collected and treated with varying degrees of care to avoid artificial contamination from expedition and laboratory equipment. All samples were collected in regions with low anthropogenic pressure, i.e. Arctic sea regions and Lake Baikal, and presumably had low buoyant plastic density.

Samples, collected with adequate precautions and analyzed in the so-called "clean lab" demonstrated low plastic content. At the same time, in samples collected in the same areas and processed without proper anti-contamination treatment a large number of microplastic particles were identified, comparable to the data obtained from highly polluted regions.

Consequently, we hypothesize that the actual human habitat is subject to a high level of

microplastic pollution, in most cases coming from everyday objects, such as microfibers from synthetic fabrics and microfragments from beverage bottles screw cups abrasion. Hence, possible risks of plastic pollution for human health are primarily due to the domestic "plastic cloud" rather than to the plastic load in products coming from the natural environment.

Astrobiological aspect of the resistance of fungal communities from desert soils to the impact of the ionizing radiation

Астробиологический аспект устойчивости грибных сообществ пустынных почв к воздействию ионизирующей радиации

Margarita Kriuchkova

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Keywords: *Astrobiology, fungi, fungal communities, desert soils, high doses, Martian conditions, ionizing radiation*

Astrobiology is the science of the origin, distribution and preservation of life in space. The scientists usually model extraterrestrial environments using the natural microbial communities of extreme Earth habitats (e.g. deserts) as the objects of investigation. The main factor that limits the existence of biological life in space is ionizing radiation. The aim of this study was to analyze the reaction of fungi communities from desert soils to the physical impact that simulates long-term presence in extraterrestrial conditions.

Samples from the upper humic horizon of grey soil (Negev desert, Israel) and grey-brown soil (Moroccan mountain desert) were the objects of the present research. The samples were irradiated with high doses of gamma-radiation (0,1 and 1 MGy) and accelerated electrons (0,05; 1; 2; 3; 4; 5 MGy) under conditions of low temperature and pressure in the climatic chamber. Some of the samples were exposed to temperature and pressure without any irradiation.

For culturing of fungi the method of soil suspensions inoculation was applied using solid Czapek medium [3] and alkaline agar [1]. Soil suspensions were preheated before inoculation (52°C, 2 min) [2]. The fungi were cultivated at temperature 5°C, 25°C, 37°C. The in situ content of fungal biomass and its morphological structure were evaluated by the method of direct fluorescent microscopy with calcofluor white, ethidium bromide and acridine orange dyes [3].

The exposure of the soil samples to 0,1 MGy gamma-radiation activated the fungal communities - the quantity of fungal propagules, the number of species and fungal biomass increased. Whereas the exposure to 1 MGy gamma-radiation led to the elimination of many species. The most resistant species that dominated after the impact of extreme conditions were *Aspergillus fumigatus* and *A. niger*.

The influence of low temperature and pressure had no significant effect on colony forming units (CFU). The impact of accelerated electrons activated the germination of species with small spores but the total biodiversity decreased. Many yeast colonies were observed after the irradiation with accelerated electrons at a dose of 1 and 2 MGy. The results obtained indicate the possibility of prolonged survival of eukaryotic natural communities in conditions of Mars regolith and outer space inside small bodies.

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Multi-walled carbon nanotubes and nanodiamonds degradation in human macrophages

Деградация многостенных углеродных нанотрубок и наноалмазов в макрофагах человека

Ekaterina Tarasova

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Keywords: *Nanotoxicity, nanobiosecurity, nanoparticles, macrophages*

The tick-borne encephalitis virus (TBEV) is a major cause of acute neurological infections in Northern Eurasia with manifestations ranging from a mild flu-like disease to severe meningitis and encephalitis. Cases of persistent TBEV infection have also been documented. Four inactivated vaccines against TBEV have been in use for several decades and have proven their efficacy, but rare cases of breakthrough infections have been described. As has been shown by detection of antibodies to non-structural proteins, vaccination against TBEV prevents the disease, but may not prevent the replication of the virus. Since the viral replication is a prerequisite for neuroinvasion and consequent viral persistence in CNS, the aim of this study was to attempt to detect the TBEV in the brain of immunized mice after infection with virulent TBEV strains. A series of experiments was conducted to assess the influence of different factors on the efficacy of vaccination.

During the experiments inbred and outbred mice of different sex and age were immunized twice using commercialy available vaccines against TBE. Two weeks later, all animals were infected with different strains and doses of the virus and monitored for disease progression and death. Samples of the brain tissue were collected and studied for the presence of TBEV RNA using RT-qPCR. Passages in cell culture and brains of suckling mice were used in an attempt to isolate the infectious virus.

Vaccination successfully protected inbred BALB/c mice from the disease after inoculation with a high dose (1600 LD_{50}) of the TBEV strain Vasilchenko. More heterogenous outbred ICR mice showed lower susceptibility to 85 LD_{50} of this strain than inbred mice, but were less protected by the vaccine. Then, three different vaccines were tested against three subtypes of the virus and demonstrated variable levels of protection. Viral RNA was detected in the brains of all survived non-immunized mice and in 38% and 26% of samples from immunized mice with and without clinical

symptoms, respectively. Thus, the vaccination provided a significant level of protection against neuroinvasion ($p<0.01$), but the virus was detected in the CNS of some healthy immunized animals. We were not able to isolate the infectious virus from any sample.

The obtained results support the overall efficacy of inactivated vaccines against an array of strains of TBEV and show that vaccination confers significant protection against neuroinvasion, but may not always prevent the virus from entering the CNS even in the absence of clinical symptoms.

MRI post-processing: a useful tool to improve detection of subtle forms of focal cortical dysplasias

Пост-обработка МРТ как метод улучшения диагностики фокальных корковых дисплазий

Anna Abramova
Faculty of Fundamental Medicine

Keywords: *Epilepsy, focal cortical dysplasias, MRI post-processing, voxel-based morphometry*

Focal cortical dysplasias (FCDs) represent a heterogeneous group of cortical development malformations which are a common cause of refractory epilepsy. Magnetic resonance imaging (MRI) is the most frequently used technique for assessing FCDs, while other more expensive methods such as magnetoencephalography or intracranial electroencephalography (EEG) can be additionally performed in cases of MRI-negative epilepsy. Since subtle forms of FCDs do not have as pronounced MRI findings as large lesions do, they present a complex problem to radiologists. MRI postprocessing has been recently demonstrated to be a valuable tool for identifying FCDs in subjects whose MRI scans were read as normal by routine visual analysis.

We present a morphometric analysis program (MAP) that can process 3D T1 MPR, T2 and T2 FLAIR image datasets obtained by a 3-T MRI scanner. The resulting sequences are processed step by step using main algorithms of voxel-based morphometry. As a result, two 3D maps are obtained: the junction image representing grey-white matter junction blurring and the extension image sensitive to abnormally located grey matter. We reviewed our database of patients with cryptogenic epilepsy who underwent standard MRI epilepsy protocol which were read as normal by radiologists and visual analysis failed to identify the area of possible FCDs. 31 subjects were included in the analysis: mean age was 35.7 years, 18 (58%) were female. 22 subjects (71%) had focal slowing in long-term video-EEG monitoring.

In 14 out of 31 patients (45%) both calculated images showed areas of increased signal, indicating extension of grey matter into white matter. In 9 out of 14 MAP-positive subjects (64%) areas of suspected FCD corresponded to those of focal slowing in EEG. After acquiring the results of MRI processing the original images were re-analyzed by

radiologists, in 11 out of 14 MAP-positive cases (79%) FCDs were diagnosed after a thorough examination of suspicious brain regions.

Since subtle FCDs are proved to be the underlying cause of formerly cryptogenic focal epilepsy it is very important both for radiologists and neurologists to be vigilant in assessing MRI images of these patients. MRI post-processing algorithm based on MAP can be a convenient supplementary tool in routine clinical practice, revealing brain regions where the area of focal cortical malformation is most likely to be located.

D-amino acid dehydrogenase (dadA) from *Pseudomonas aeruginosa* as an instrument for controlling intracellular pyruvate concentration

Дегидрогеназа D-аминокислот из *Pseudomonas aeruginosa* как инструмент для изменения внутриклеточной концентрации пирувата

Dina Bass

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Keywords: *pyruvate, mitochondria, fluorescent sensors, metabolic engineering*

Pyruvate is a key molecule in eukaryotic metabolism, and its production, transport and utilization are disturbed in a wide spectrum of pathological conditions. In this work, we examine whether bacterial D-amino acid dehydrogenase (dadA) expressed in mammalian cells can influence biological processes by producing pyruvate from D-alanine. D-amino acids are practically absent in mammalian cells, therefore the activity of dadA is controlled by external addition of the substrate.

In order to specify native dadA localization and condition in human cells we produced rat polyclonal anti-dadA antibodies. To this end, dadA carrying His6-tag was expressed in *E.coli* strain XL1-Blue and purified by metal affinity chromatography. Since dadA seems to be associated with cell membranes, denaturing conditions such as buffers containing urea and Triton X-100 were most productive. The polyclonal antibodies were purified from rat immune serum on dadA-conjugated sepharose and proved to be specific against dadA. An immunocytochemical assay on HeLa cells expressing native dadA was performed, and the enzyme turned out to form aggregates in cytosol, which was likely to inhibit enzyme activity and to disturb cell processes.

To increase the solubility of dadA fusion constructions with fluorescent proteins mRuby2 and EGFP were obtained. The fusion proteins retained the native activity *in vitro*, showed no aggregation in HeLa cells cytosol and were properly localized in mitochondria when expressed with N-end tdmito localization sequence. The impact of pyruvate generation on mitochondrial potential was tested by fluorescent microscopy of HeLa cells expressing tdmito-EGPF-dadA construct with membrane potential indicator tetramethylrhonamine methyl ester (TMRM). After the administration of D-alanine, a statistically significant increase of TMRM fluorescence was observed compared to the control cells expressing tdmito-EGFP.

In addition to enzymatic activity, the specificity of dadA was tested. To this end, HeLa cells expressing tdmito-mRuby-dadA and mitochondrial version of hydrogen peroxide sensor HyPer 3 were treated with D-alanine. The control cells expressed an inactive mutant dadA where two conservative tyrosine residues presumably involved in FAD binding were replaced by two alanine residues. Neither wild-type nor mutant dadA generated hydrogen peroxide under experimental conditions.

These data suggest that dadA is an effective instrument for controlling pyruvate concentration in mitochondrial matrix, which can dramatically change carbon metabolism in the cell. However, since the changes in pH and FAD pool state provoked by dadA activity can also influence cell processes, this instrument needs further validation.

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The flora of the Luven'ga Archipelago, the Kandalaksha Gulf, the White Sea

Флора Лувеньгского архипелага (Кандалакшский залив, Белое море)

Elena Vuzman

Faculty of Biology, Department of Ecology and Plant Geography

Keywords: *insular flora; vascular plants; Murmansk Region; alien species*

The biodiversity conservation is an essential task of our time. This is especially relevant for the northern territories due to their vulnerability and rising anthropogenic pressure. The Kandalaksha nature reserve has been created for saving numerous islands of Kandalaksha Gulf of the White Sea. Thorough investigation of biodiversity of protected areas is important for their potential conservation and management.

The Luven'ga Archipelago is located along the north coast at the top of the Kandalaksha Gulf and represented by 41 islands with a total area of 249 hectares. Field work was carried out from 2016 to 2018 with using detail route method. As a result, a check-list of all floral descriptions of the Archipelago was compiled as well as 320 herbarium specimens were collected.

The flora of the Archipelago consists of 274 species of 53 families; 71 species are given for the first time. The dependence of the number of species on the area of the island is clearly visible and can be expressed by the Arrhenius equation $y = 69 * x0.24$ ($R2 = 0.8$, $p < 0.05$). It can be assumed that there are 69 species on an island of 1 hectare. Moreover, 10 protected species of the Red Book of Murmansk region and 1 species of the Red Book of the Russian Federation were found. Alien flora is represented by 29 species and makes up 11% of the archipelago flora. Therefore, we assess anthropogenic influence on the islands as weak, although three general introduction ways of alien species were traced. The first way is associated with direct impact on Bolshoy Berezovii Island in the past as a result of using the territory for fishing evidenced by the findings of the species noted in the Kandalaksha Gulf near the Pomorian settlements only. The second is related to haymaking on the islands at the beginning of the 20th century, as it is known from the literature and indicated by some herb species. The third way is a modern increase in ecosystem synatropization and dispersal of alien species from adjacent human developed territories.

This study is necessary to understand the effect of anthropogenic influences on the flora in the past. It allows to predict the possible transformation in the future due to increasing anthropogenic pressure on the north ecosystems.

Cell model for *in vivo* investigation of *MYC* and *IGH* locus dynamics

Клеточная модель для изучения динамики локусов *MYC* и *IGH in vivo*

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Keywords: *DNA visualization, genome editing, ANCHOR, Burkitt lymphoma, cell model, CRISPR/Cas*

Spatial and temporal dynamics of chromatin is indispensible for a broad range of DNA-associated processes like transcription, DNA replication and repair. It has become evident that proximity of different loci in a nucleus increases the probability of chromosomal translocations found in cancer patients. One example of such rearrangement is *MYC-IGH* translocation between a potent oncogene *c-MYC* and Immunoglobulin heavy chain locus (*IGH).* This translocation is associated with Burkitt lymphoma which is overrepresented in HIV-patients. Recently, it has been revealed by FISH-imaging that HIV regulatory protein called tat induces colocalization of *MYC* and *IGH* loci, facilitating the oncogenic rearrangement between these loci [1]. We aimed to develop a cell model with which it will be possible to investigate the influence of HIV tat protein on spatial dynamics of *MYC* and *IGH* loci in living cells. A suitable method for live cell loci imaging is ANCHOR technology which was developed in Bystrycky laboratory in 2014 [2].

Firstly, we chose several guide RNAs directing Cas9 to *MYC* or *IGH* loci for further integration of ANCHOR system elements into these loci. The efficiency of these guide RNAs was tested by ENIT-approach [3] in HeLa cells. Then homology arms flanking the site of the most efficient guide RNA in *MYC* gene were PCR-amplified from genomic DNA. The homology arms were inserted into a plasmid vector containing ANCH1 sequence and OR1-GFP gene by Gibson assembly protocol. This plasmid was subsequently transfected into HeLa cells. Two weeks after transfection cells were sorted by FACS based on GFP-fluorescence. Forty days after transfection the sorted cells were analyzed by confocal microscopy. Cells containing GFP-foci corresponding to *MYC* locus were identified by confocal microscopy of the sorted cells. The integration of type I ANCHOR system into target *MYC* locus was verified by PCR.

We obtained a cell line in which the location of MYC locus is visualized by type I ANCHOR system. The observed foci were bright green spots on dark background of the nuclei, while the cytoplasm was intense green, suggesting that OR1-GFP has a cryptic nuclear export signal. This allows achieving high signal to noise ratio. The developed cell line will be used for further integration of type III ANCHOR system into

IGH locus and for studying the impact of tat protein on the proximity of *MYC* and *IGH* loci.

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Protective effects of new PAR1 agonist peptide in the mouse model of photothrombosis-induced brain ischemia

Защитные эффекты нового пептида-агониста ПАР1 в модели фотоиндуцированной ишемии головного мозга у мышей

Maksim Galkov

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Keywords: *Protease-activated receptor 1 (PAR1), PAR1 peptide agonist (AP9), activated protein C, β-arrestin-2, photothrombosis-induced brain ischemia*

Activated protein C (APC) is a multifunctional serine protease of the blood coagulation system that demonstrates cytoprotective effects via cleavage of protease-activated receptor 1 (PAR1) and activation of β-arrestin-2-dependent signal pathways. Recently, protective properties of peptide analogs of PAR1 N-terminal domain released by APC

have been revealed using primary cultures of neurons and astrocytes. Therefore, these peptides are expected to show APC-like action in ischemic conditions *in vivo*.

In the present work, we used a nine-amino acid peptide (AP9), which mimics PAR1 N-terminal sequence generated by APC-mediated cleavage. To assess AP9 action *in vivo*, a mouse model of photothrombosis-induced (PT-induced) ischemia was chosen. We compared the effects of single (10 min before PT) and double (10 min before and 1 h after PT) administration of the peptide at a dose of 20 mg/kg. Lesion volume was measured by magnetic resonance imaging (MRI) and brain section staining with tetrazolium salt. To estimate neurological dysfunction of mice, we used the cylinder and the grid-walk tests. Blood-brain barrier (BBB) disruption was assessed by Evans blue dye extraction. Eosin and hematoxylin staining and immunohistochemical approach were applied to count the number of undamaged neurons and activated glial cells in the cerebral cortex after PT.

According to MRI data, both single and double administration of AP9 decreased lesion volume. In addition, double AP9 administration reduced BBB disruption and neurological dysfunction in mice. However, no effects of the peptide on the number of undamaged neurons and activated glial cells were detected. Brain section staining with tetrazolium salt did not show the protective action of AP9 after PT in mice lacking β-arrestin-2.

In summary, the new PAR1 peptide agonist AP9 demonstrates APC-like protective effects in PT-induced brain ischemia. The presented data indicate that the action of AP9 is primarily due to the stabilization of the BBB after thrombosis. Neurons, astrocytes and endothelial cells can be considered potential targets for AP9 in the nervous tissue, since these cell types are known to express PAR1. The activation of PAR1 by AP9, as well as APC-mediated cleavage of the receptor induce β-arrestin-2-dependent cytoprotective pathways. These results expand the understanding of the role of PAR1 in thrombosis-induced ischemia. Moreover, they reveal a potential strategy to treat ischemic brain injuries by a new class of peptide neuroprotectors.

Epigenetic mechanisms of regulation of Parkinson's disease and the design of an experiment on the study of methylation status of genes involved in PD pathogenesis

Эпигенетические механизмы регуляции болезни Паркинсона и дизайн эксперимента по изучению статуса метилирования генов, вовлеченных в патогенез БП

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Keywords: *Parkinson's disease, DNA methylation, bisulfite sequencing, epigenetics*

In modern medicine, there is an acute issue of understanding the role of epigenetic regulation of neurodegenerative diseases that have complex heterogeneous pathogenesis, such as Parkinson's disease (PD). There are 6.2 million patients worldwide (1/100 patients are over age 60) and 60 000 new patients are diagnosed with PD every year. PD is characterized by severe progressive degeneration of dopaminergic neurons in *Substantia nigra*; and decreased dopamine levels in *Corpus striatum*, which causes the classic tetrad of motor symptoms: muscle rigidity, hypokinesia, tremor, postural instability. PD has no treatment, early diagnostics is difficult and the cause of the disease is unknown, but both genetics and epigenetics are involved.

The main mark in the methylome (DNA methylation profile, one of the factors of epigenetic regulation) is a methyl group at the fifth carbon of cytosine in the CpG islands - accumulations of CG-sites (cytosine followed by guanine) in DNA, which can be located near the areas with which transcription factors interact, thereby influencing gene transcription.

We have found 3 pairs of monozygotic PD-discordant twins and received the material from which fibroblast culture has been made. Then, we extracted DNA and RNA from the culture and carried out Whole Transcriptome Analysis. According to the results, we have identified differentially expressed genes, and we have chosen genes associated with PD pathogenesis based on Gene set enrichment analysis. Simultaneously, Bioinformatic analysis of the database of cancer cell lines DNA methylation profiles was performed and genes with differential methylation were selected. By results of the analysis of DNA methylation and the analysis of transcription expression of genes that are involved in PD pathogenesis we suggested 3 genes that are possibly involved in epigenetic regulation of PD.

We have now designed the experiment to estimate methylation status of genes selected. Methylation was chosen, because it has the most convenient way of investigation, called bisulfite sequencing (*Parrish et al., 2012*). We are going to convert DNA of the fibroblast cell culture using sodium bisulfite, which reacts with Cytosine turning it to Uracil, but there is no reaction with 5-methylcytosine. After the bisulfite conversion we

will amplify the fragments with CpG islands with primers we have designed. So, we will carry out Sanger sequencing, compare peaks of 2 alleles of the genes on the fluorograms and calculate the Methylation percentage of the genes. The percentage will show, which of the genes are unmethylated (0%), hemimethylated (50%) or fully methylated (100%).

Antioxidant enzyme defense systems of anoxygenic phototrophic bacteria

Ферменты антиокислительной защиты аноксигенных фототрофных бактерий

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Keywords: *reactive oxygen species, antioxidant enzymes, phototrophic bacteria, bioinformatics analysis*

During electron chain reactions oxygen forms highly reactive toxic radicals and molecules – reactive oxygen species (ROS). Overproduction of ROS has significant implications in conditions ranging from cardiovascular disease to neurological disorders and lung pathologies. Much work has been done on bacterial enzymes responsible for ROS neutralization due to their attractive antioxidant ability in drugs, cosmetic products and biological supplements. This research aims to examine characteristics of key defense enzymes superoxide dismutase (SOD), catalase and peroxidase in anoxygenic phototrophic bacteria.

Facultative anaerobic purple sulfur bacteria *Thiocapsa roseopersicina* BBS, *Ectothiorhodospira shaposhnikovii* N1, purple nonsulfur *Rhodospirillum rubrum* 2R, *Rhodopseudomonas palustris* 286 and strictly anaerobic green sulfur *Chlorobaculum limnaeum* 319 were routinely cultivated photoautotrophically and chemoautotrophically in an appropriate medium under aerobic and anaerobic sterile conditions. In order to isolate cells from nutrient media the biomass was centrifuged with Tris-HCl buffer. Sedimented cells were broken by 3 min passages through an ultrasonic disintegrator with subsequent centrifugation for removing cellular fragments. Then the obtained extracts underwent spectrophotometric SOD measuring by inhibition of cytochrome *c* reduction according to the xanthineoxidase-cytochrome approach. Hydrogen peroxide

and modified sulfonic acid solutions were applied for catalase and peroxidase identification. In addition, bioinformatics analysis of the distribution of antioxidant enzyme genes among phototrophic bacteria was carried out.

The highest SOD activity was revealed in purple sulfur bacteria whereas purple nonsulfur bacteria demonstrated high catalase activity. Under aerobic conditions enzyme activities doubled. By contrast, green bacteria expressed extremely low activities, nevertheless, rising in aerobic conditions. Peroxidase values were at the threshold of sensitivity of the technique. Bioinformatics research demonstrated that SOD and bifunctional catalase gene couple is the predominant combination of the defense system genes in the phototrophic bacteria in all genera.

High enzyme activity in aerobic conditions is proposed to be the cell answer to oxidative stress induced by molecular oxygen facilitating ROS formation which damages nucleic acids and lipid membranes. We suggest that such defense strategy is associated with ecological factors as purple sulfur bacteria face oxygen toxicity daily in the tidal zone. Purple nonsulfur bacteria inhabit lower cyanobacterial mat layers with reduced oxygen, therefore, catalase instead of SOD is the primary antioxidant. In terms of evolution, SOD and catalase have ancient history and have archaeal and eukaryotic homologues. The enzymes were likely to be present in the last universal common ancestor, which probably explains gene presence in all phototrophic bacteria.

Synthesis and research of physical and chemical properties of liquid crystalline compounds based on 2,3,4-tris (alkyloxy) benzenesulfonic acid

Синтез и исследования физико-химических свойств жидкокристаллических соединений на основе 2,3,4-трис(алкилокси)бензолсульфоновой кислоты

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Keywords :*Amphiphiles, self-organizing ensembles, liquid crystal*

The aim of the work is the synthesis and study of amphiphilic compounds based on 2,3,4-tris (dodecyloxy) benzenesulfonic acid. Amphiphilicity is the property of molecules that have both lyophilic and lyophobic properties. Molecules that make up biological membranes are amphiphilic. Due to intermolecular interactions the synthesized molecules form self-organizing supramolecular ensembles. The materials created with the help of such ensembles are very convenient to use and interesting in

the study, as one can control the structure, if the conditions are changed. This allows significantly influence the material's ionic conductivity. Thus, this class of compounds has great potential in the creation of biological membranes.

It is also worth noting that all synthesized substances can occur in a liquid crystalline state. This is the state that combines the rheological properties of liquid bodies with those of solids, such as, for example, the anisotropy of physical properties.

The synthesis of the 2,3,4-tris (dodecyloxy) benzenesulfonic acid precursor was carried out in two stages. The first step was the synthesis of 1,2,3-tris- (dodecyloxy) benzene (TDOB). The compound obtained was then sulfonated to give 2,3,4-tris (dodecyloxy) benzenesulfonic acid(TDOBSA). The reaction yield was -60%. Using NMR, IR spectroscopy, and elemental analysis, the synthesized substance was proved to correspond to the formula 2,3,4-tris (dodecyloxy) benzenesulfonic acid. Two peaks were found on melting thermograms obtained using the DSC method, which, together with the information obtained using POM, suggests that the synthesized substance has a liquid crystalline phase in the temperature range 65-84 ° C.

Then, by dissolving in 10 ml of pyridine TDOBSA, the pyridine salt of 2,3,4-tris (dodecyloxy) benzenesulfonic acid was obtained. The yield was 85%. Using NMR, IR spectroscopy, and elemental analysis, the synthesized substance was shown to correspond to the formula pyridine 2,3,4-tris (dodexyloxy) benzenesulfonate. Using the DSC and POM method, it was established that the substance had an LCD phase in the temperature range 100-105.

The sodium salt of 2,3,4-tris (dodecyloxy) benzenesulfonic acid was also synthesized. The synthesis was carried out in a nitrogen atmosphere by adding 2,3,4-tris (dodecyloxy) benzenesulfonic acid to sodium methylate dissolved in methanol. The yield was 80%. Now we are deciphering the obtained NMR spectrum of this substance, as well as studying the structure of phase transitions and establishing the chemistry of the obtained salt.

The next step in this work will be the study of the obtained substances in order to establish the exact parameters of their structure by high-angle X-ray diffraction.

Post-transcriptional regulation of rRNA genes with R2 transposon insertions by Piwi protein

Piwi-опосредованная пост-транскрипционная регуляция генов рРНК с инсерциями транспозонов R2

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Keywords: *Epigenetics, ribosomal DNA, RNA interference, transposable elements*

Eukaryotic ribosomal DNA comprises hundreds of tandemly repeated rRNA genes, some of which are repressed under normal conditions via the unrevealed mechanism. In *Drosophila melanogaster* up to 40% of rRNA genes contain insertions of R1 and R2 retrotransposons that are widespread in the animal kingdom. R2 elements integrate exclusively in a certain site in the 28S rRNA sequence and lack their own promoter. Consequently, these transposons are transcribed as a part of pre-rRNA and can then be excised by self-splicing. However, many shortened R2 transposons with truncated 5'-ends are not able to perform self-cleavage. Generally, damaged rRNA genes with transposon insertions are transcribed at a very low level, but mechanisms of their inactivation remain poorly understood. We have found an rRNA gene with an extremely shortened R2 insertion, which displays a relatively high level of expression. RNA interference by Piwi protein and piRNA is one of the main pathways of transposon repression in animals. It was previously shown by our group that Piwi protein accumulates in the nucleolus. Then we have found small RNAs (including piRNA) that are mapped on both sense and antisense strands of R2 transposon.

Interestingly, we have found that the mutations of piRNA-binding protein Piwi lead to an additional drastic increase of the shortened R2 transcript level, whereas exert a mild effect on the expression of full-size R2 elements. Unexpectedly, while using chromatin immunoprecipitation, we found that this Piwi-dependent activation of the R2-containing rRNA gene is not accompanied by changes of the H3K9me3, H3K4me2 and some other chromatin marks (H3K9ac, H3K27me3, and HP1a protein) which are usually associated with piRNA-mediated transcriptional silencing of other transposable elements. This result contests the classical mechanism of Piwi-dependent repression and may imply a post-transcriptional mode of acting. It was validated by the nuclear run-on assay which reflects only nascent transcription. The assay has not shown any significant differences

in the short R2 transcription in the presence and absence of Piwi. Moreover, we found that transcripts with R2 insertion demonstrate a lower rate of degradation in the absence of Piwi compared to the transcripts from flies with the functionally active Piwi protein. These findings point to a novel mechanism of post-transcriptional Piwi-mediated repression.

Acoustic, morphological and genetic differentiation of chaffinches (*Fringilla coelebs*) in the contact zone of Crimean and Caucasian subspecies

Акустическая, морфологическая и генетическая дифференциация зяблика (*Fringilla coelebs*) в зоне контакта крымского и кавказского подвидов

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Keywords: *songbirds, acoustics, populations, differentiation*

Spreading and differentiation of birds remain an interesting, but poorly studied problem. Typically, the speciation of songbirds is registered according to fluctuations in songs and calls within the areas studied. The areal of European chaffinch subspecies is perceived to be extended to marshland in the North Caucasus. The range of Caucasian chaffinch is restricted in the north of Caucasus by Armenian Highlands and in the south by Talysh mountains. Crimean chaffinch is spread across the Crimean peninsula.

We have recorded singing chaffinches in contact and habitual areas of the three subspecies to clarify interrelations between song repertoires of the populations. Besides, to investigate the genetic status of each group and the availability of possible hybridization, we have also collected 11 blood samples of F. c. caucasica, 8 blood samples of F. c. solomkoi, 6 samples from the contact zone of Caucasian and European chaffinch in the Rostov region and also 14 samples from the contact zone of F. c. caucasica and F. c. solomkoi in the north-west of Caucasus. In addition, to compare these highly questionable allopatric populations with ascertainable European chaffinch, we have recorded a series of songs and collected one blood sample in Moscow as well.

Unlike the rain-calls of European chaffinch (Fringilla coelebs coelebs), which have a form of a short trill, rain-calls of Caucasian (F. c. caucasica) and Crimean (F. c. solomkoi) chaffinches represent modest whistles that are distinguished by frequency. However, in the contact zone of F. c. caucasica and F. c. solomkoi chaffinches use the high-frequency with the low-frequency whistles interchangeably, as can be also seen from literature. It is noteworthy that such a phenomenon was observed only in the Utrish reserve, but with over 75 km to the east, the alternating calls were not recorded.

Thus, the boundary between a purely Caucasian subspecies and a hybrid population can be revealed. DNA was isolated from the collected blood samples. Based on the sequence of cytochrome B a phylogenetic tree was created. Such data seem to indicate that the separation by cytochrome B in chaffinch subspecies is not yet too strong. It is necessary to study nuclear DNA and make a comparison by microsatellites, as well as to compare the repertoires of chaffinch songs in the study area. With these data we could understand whether the birds' calls are inherited or represent cultural phenomenon.

Exoproteases of micromycetes with keratinolytic activity

Экзопротеазы микромицетов с кератинолитической активностью

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Keywords: *proteases*, *micromycetes*, *keratinolysis*, *biotechnology*

Keratin is a fibrillar, hard-to-digest protein found in agricultural waste such as wool and feathers. This type of waste is currently disposed of by incineration, which prevents the reuse of processed products. However, keratin-rich wastes are a valuable source of oligopeptides and amino acids, the use of which is possible as fertilizers, feed additives, as well as components of cosmetic and medical preparations. In this regard, the search for new producers of proteolytic enzymes with keratinolytic activity and their study are important goals of modern biotechnology.

Filamentous fungi are known as producers of exoproteases with broad substrate specificity. Therefore, primary screening was conducted on 36 cultures of micromycetes of the genera *Aspergillus*, *Penicillium*, *Ulocladium*, *Paecilomyces*, *Cladosporium* and

Chaetomium. At this stage microorganisms were cultivated on agar media containing target substrates, such as keratin and casein. The values of enzymatic indices (EI) of the cultures were determined by the size of the hydrolysis zones on these media. *Aspergillus giganteus*, *A. ochraceus*, *A. amstelodami* and *Cladosporium sphaerospermum* showed the highest EI value on casein medium in combination with the presence of a hydrolysis zone on keratin medium.

Subsequently, these micromycetes were cultivated in liquid media, and the culture fluid was used for the quantitative analysis of proteolytic activity. The reactions were carried out with suspensions of native proteins, the amount of the product was identified spectrophotometrically. It was established that *A. giganteus* exhibited the highest keratinolytic activity among the studied cultures. To increase the yield of the product, we examined accumulation dynamics of exoproteases produced by *A. giganteus* and active against casein and keratin on media with different sources of nitrogen (organic, mineral and mixed). The highest activity of keratinolytic enzymes is achieved by cultivating *A. giganteus* on the medium with feather meal and addition of mineral and organic (easy-to-digest) nitrogen compounds in small quantities, which also confirms the potential of this micromycete as a producer of industrially important proteases active against hard-to-digest proteins.

Thus, combining microbiological and biochemical approaches it was demonstrated that filamentous fungi can likely be used for the synthesis of proteolytic enzymes, which will make recycling of agricultural waste more sustainable and cost-effective by producing value-added products.

Regulation of neutrophil and eosinophil recruitment in *aspergillus fumigatus*-induced allergic airway inflammation

Регуляция притока нейрофилов и эозинофилов в дыхательные пути при аллергическом воспалении, вызванном экстрактом *Aspergillis fumigatus*

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Keywords: *Asthma, mouse model, Aspergillus fumigatus, eosinophils, neutrophils*

Neutrophils are regulatory cells that can release inflammatory mediators to affect inflammation development. Nevertheless, in allergic airway inflammation, eosinophils play a key part in this reaction. The present study is aimed to investigate the mechanisms underlying the switching from neutrophil- to the eosinophil-mediated response.

To induce allergic airway inflammation, we used mice model organisms treated with multiple oropharyngeal administrations of *A. fumigatus* extract in low doses. The total number of extract inhalations ranged from three (short allergic model) to six (long allergic model). After 72 hours, the blood samples were collected from each mouse treated with *A. fumigatus* extract. To induce acute neutrophil-mediated inflammation, mice received one high dose of *A. fumigatus* extract through the oropharyngeal application. The measurement of bronchoalveolar lavage (BAL) cells was performed by flow cytometry and cytospin staining. ELISA was used to identify cytokines in lavage and also to determine the presence of allergen-specific IgA, IgG and total allergen-specific IgE in peripheral blood and BAL fluid.

During the first week of the experiment, no increase in eosinophil count was observed. However, in 72 hours after the 3rd low dose of *A. fumigatus* extract administration, the number of eosinophils in the blood was significantly increased and reached 20% of total blood cells. Total BAL cell number was elevated in mice with both allergic and acute inflammation compared to intact mice. At the same time, no significant difference between mice with allergic and acute inflammation was observed. In both short and long allergic models infiltraiting airway cells were mainly represented by eosinophils, while acute inflammation was mediated primarily by neutrophils.

Increased levels of IL-4 and allergen-specific blood IgG were detected in the long allergic model. Mice with the short allergic model of inflammation were characterized by significantly elevated eosinophil count, however, BAL fluid IL-4 and allergen-specific peripheral blood IgG levels were not significantly increased compared to mice with acute inflammation and to intact mice. Mice with acute inflammation showed upregulated BAL fluid levels of TNF-alpha and IFN-gamma. BAL fluid allergen-specific IgA levels were significantly elevated in both types of allergic models, although it remained unaltered in acute inflammation compared to intact mice.

We concluded that eosinophil-mediated allergic airway inflammation can be induced in the lack of adaptive immune response activation. According to our hypothesis, the upregulation of eosinophil-mediated response and downregulation of neutrophil-mediated inflammation are two independent processes during the allergic airway inflammation development.

High-throughput screening for inhibitors of protein biosynthesis in bacterial cells

Высокопроизводительный поиск ингибиторов синтеза белка в клетках бактерий

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Keywords: *high-throughput screening, inhibitors of protein biosynthesis, pdualrep2 system*

It is well known that in everyday life a person encounters a huge number of pathogenic bacteria that cause severe diseases. Compared to the 20th century, modern medicine has made great strides in the development of new technologies. Despite this, today the treatment of diseases is of paramount importance in connection with the development of bacterial resistance to almost all existing types of antibiotics, even of a new generation. Our objectives were to search for novel potential antibiotics that affect protein biosynthesis or induce SOS response. We used high-throughput screening based on pdualrep2 reporter construction of various chemicals supplied by InterBioScreen and ChemRar. Such system was used for elucidating active compound mechanisms of action by performing *in vitro* and *in vivo* experiments.

Recently, due to a unique double reporter system created in our laboratory it has become possible to identify substances that lead to disruption of protein biosynthesis or induce SOS-response due to DNA damage. This reporter system consists of a plasmid *pdualrep2* with the red fluorescent gene RFP placed under SOS-inducible *sulA* promoter and the far-red fluorescent gene Katushka2S inserted downstream the tryptophan attenuator. Such modification allowed the Katushka2S expression only in the presence of substances that stall the ribosome on the leader peptide preventing premature termination.

The plasmid was transformed into *E.coli* strain *BW25113* and *JW5503* strain lacking the *tolC* gene. Initially, various chemical natural and synthetic compounds were tested on these strains seeded on Petri dishes. The substances that induced the ribosomal reporter were tested in non-cellular translation and *in vivo* experiments with labeled C^{14} phenylalanine amino acid. If a potential antibiotic disrupted protein biosynthesis in acceptable concentrations (approximately 50 μg / ml) in *in vitro* and *in vivo* experiments, a toe-print was subsequently performed to understand which stage of that process was affected. 150 out of 20,000 substances that underwent high-throughput screening induced a ribosomal reporter. Among them, only 30% were selected for *in vitro* and *in vivo* experiments, and only 2 substances were selected for subsequent toe-print. Only two substances with *ID* numbers STOCK4S-83826 (2-phenylindolizine-7-carboxylate (IBS)) and STOCK6S-38177 ((2-thioxothiazolidin-3-yl)-3-methylbutanoic acid (IBS)) turned out to be antibiotics that block the functioning of the ribosome.

Henceforward, it is planned to search for resistant clones to these compounds and perform a whole-genome sequencing of the selected clones. This will provide an opportunity for a more detailed study of the mechanism of work of these substances.

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