Študijný program / *Study programme:*
Biofyzika / *Biophysics*

Témy dizertačných prác

Dissertation Thesis Descriptions

Študijný program / *Study programme:*
Biofyzika / *Biophysics*

Názov / *Title*
Funkcionálne nanoštruktúry - magnetotozómy a etozómy ako nosiče liečiv v protinádorovej terapii.
Functional nanostructures - magnetosomes and ethosomes as a drug carriers in anticancer therapy

Jazyk záverečnej práce / *Language of Thesis*
slovenský / *Slovak*

Školiteľ / *Tutor*
prof. RNDr. Melánia Babincová, DrSc.

Anotácia / *Annotation*
V poslednom období sa do popredia výskumu v biofyzike dostávajú aplikácie metód nanotechnológie na efektívnu terapiu najmä nádorových ochorení. Cieľom dizertačnej práce je príprava magnetozómov a etozómov so zabudovanými liečivami pre cielený transport v organizme, testovanie ich stability, transport magnetozómov vplyvom magnetického poľa, uvoľnenie liečiva vplyvom vysokofrekvenčného poľa. Analýza penetračnej schopnosti etozómov na modelovom systéme kožného tkaniva. Účinok terapie pomocou týchto nosičov liečiva sledovať pomocou viability nádorových buniek in vitro a in vivo.

Literatúra / *Literature*
1. Altanerova, U., Babincova, M., Babinec, P., Benejova, K., Jakubechova, J., Altanerova, V., Zduriencikova, M., Repiska, V. & Altaner, C. 2017, "Human mesenchymal stem cell-derived iron oxide exosomes allow targeted ablation of tumor cells via magnetic hyperthermia", International Journal of Nanomedicine, vol. 12, pp. 7923-7936. 2. Babincová, M., Vrbovská, H., Sourivong, P., Babinec, P. & Durdík, Š. 2018, "Application of albumin-embedded magnetic nanoheaters for release of etoposide in integrated chemotherapy and hyperthermia of U87-MG glioma cells", Anticancer Research, vol. 38, no. 5, pp. 2683-2690.
1. Altanerova, U., Babincova, M., Babinec, P., Benejova, K., Jakubechova, J., Altanerova, V., Zduriencikova, M., Repiska, V. & Altaner, C. 2017, "Human mesenchymal stem cell-derived iron oxide exosomes allow targeted ablation of tumor cells via magnetic hyperthermia", International Journal of Nanomedicine, vol. 12, pp. 7923-7936. 2. Babincová, M., Vrbovská, H., Sourivong, P., Babinec, P. & Durdík, Š. 2018, "Application of albumin-embedded magnetic nanoheaters for release of etoposide in integrated chemotherapy and hyperthermia of U87-MG glioma cells", Anticancer Research, vol. 38, no. 5, pp. 2683-2690.

Študijný program / *Study programme:*
Biofyzika / *Biophysics*

Názov / *Title*
Proteomický prístup k štúdiu úlohy srdcových mitochondrií v kardioprotekcii
Proteomic approach to the study of the role of cardiac mitochondria in cardioprotection

Jazyk záverečnej práce / *Language of Thesis*
slovenský / *Slovak*

Školiteľ / *Tutor*
doc. RNDr. Iveta Waczulíková, PhD.

Konzultant / *Consultant*
RNDr. Milan Zvarík, PhD.

Konzultant / *Consultant*
Ing. Miroslav Ferko, PhD.

Anotácia / *Annotation*
Predchádzajúci výskum v rôznych oblastiach ukazuje, že mitochondrie sú významným faktorom v patogenéze a progresii civilizačných ochorení. Poznatky v oblasti experimentálnej kardioprotekcie sú bázou pre návrh stratégií zameraných na zabránenie mitochondriálnej dysfunkcie, ktorá predchádza štruktúrnym a funkčným zmenám srdca a finálne jeho zlyhaniu. Nové etapy výskumu sa zameriavajú na mechanizmy na urovni proteínov mitochondrií, ktoré sa podieľajú na zabezpečení energetických požiadaviek srdca v podmienkach jeho zvýšených energetických nárokov. Takéto podmienky je možné experimentálne navodiť farmakologickým, vzdialeným ischemickým, metabolickým, či hypoxickým preconditioningom a následne hodnotiť zmeny na rôznych úrovniach organizácie, ktoré sú súčasťou bioenergetickej adaptácie. Dnes sú k dispozícii moderné experimentálne a analytické metódy, ktoré umožňujú študovať štruktúru, funkciu a dynamiku mitochondrií. Metódy hmotnostnej spektrometrie a vysokoúčinnej kvapalinovej chromatografie (LC-MS a HPLC) umožňujú výskum na úrovni proteómu a poskytujú tak priamu informáciu o zmenách v proteín-proteínových interakciách mitochondriálnych proteínov, čo môže pomôcť pri objasnení signálnych dráh v procesoch kardioprotekcie a úlohy, ktorú v nej zohráva inhibícia otvárania mitochondriálnych pórov prechodnej permeability (mPTP). Výsledky dizertačnej práce prispejú k znalostnej báze a zvýšia šancu, že sa poznatky z oblasti kardioprotekcie v reálnej dobe povedú k aplikáciám v klinickej praxi.

Cieľ / *Aim*
1. s využitím proteomických a metabolomických analýz študovať zmeny v bioenergetike mitochondrií srdca v experimentálnych modeloch preconditioningu 2. identifikovať zmeny vedúce v podmienkach preconditioningu ku kardioprotekcii. 3. sledovať zmeny indukované kardioprotektívnou remodeláciou membrán srdcových mitochondrií z hľadiska ich biofyzikálnych a biochemických vlastností 4. overiť, do akej miery sú komplexy dýchacieho reťazca mitochondrií zapojené do adaptačných procesov v podmienkach nedostatku kyslíka. Identifikovať zmeny na úrovni proteínov tvoriacich komplexy dýchacieho reťazca a ich vzájomných proteín-proteínových interakcií.

Literatúra / *Literature*
1. ANDELOVÁ, N. et al., 2020, mPTP Proteins Regulated by Streptozotocin-Induced Diabetes Mellitus Are Effectively Involved in the Processes of Maintaining Myocardial Metabolic Adaptation. International Journal of Molecular Sciences, 21, pii. 2622, doi: 10.3390/ijms21072622.
2. GVOZDJAKOVÁ A., 2008, Mitochondrial medicine: Mitochondrial Metabolism, Diseases,

Diagnosis and Therapy. Springer Verlag, 410 s., ISBN 978-l-4020-6713-6 3. HIANIK T., 2006, Structure and physical properties of biomembranes and model membranes. Acta Physica Slovaca 56(6) , DOI: 10.2478/v10155-010-0082-z 4. Kolektív autorov: Biomembrány: Štruktúra dynamika a membrán vo vzťahu k bunkovým funkciám. Editor: Ľubica Lacinová. Bratislava: ISBN Petrus. 255 978-80-89233-46-5 5. KALTASHOV I.A., EYLES S.J., Mass Spectroscopy in Biophysics: Conformation and Dynamics of Biomolecules. Wiley-Interscience; 1st edition, ISBN-13: 978-0471456025 6. JACKSON M.B., 2006, Molecular Cellular and Biophysics. Cambridge University Press 5I2s. ISBN-13 9780521624701 7. LAKOWICZ, J.R., 2006, Principles of fluorescence spectroscopy. 3.ed. Plenum Press, New York, ISBN 978-0-387-31278-1

Poznámka / *Comment*

V spolupráci s CEM SAV (Dr. Miroslav Ferko). Výsledky dizertačnej práce budú súčasťou bežiacich národných (APVV a VEGA) projektov.

Študijný program / *Study programme:*
Biofyzika / *Biophysics*

Názov / *Title*
Štúdium nanosystému lipidových alebo polymérnych nanočastíc pre cielenú terapiu onkologických ochorení
Study of the nanosystem combing lipid and polymer nanoparticles for targeted drug delivery in the cancer treatment

Jazyk záverečnej práce / *Language of Thesis*
slovenský / *Slovak*

Školiteľ / *Tutor*
prof. RNDr. Tibor Hianik, DrSc.

Konzultant / *Consultant*
Mgr. Zuzana Garaiová, PhD.

Anotácia / *Annotation*
Cieľom dizertačnej práce bude optimalizácia prípravy lipidových a polymérnych nanočastíc ako nosičov liečiv pre účely cielenej terapie, konkrétne 1) štúdium pasívnej a aktívnej enkapsulácie terapeutík 2) modifikácia cieliacimi molekulami, napr. DNA aptamérmi; 3) štúdium interakcie pripraveného nanosystému s vybranými bunkovými kultúrami – preskúmanie internalizácie nanočastíc a viability buniek.
The aim of the thesis will be the optimalisation of the preparation of lipid and polymer nanoparticles as carriers of biomedicals for targeted therapy. This will consists in 1) the study of passive and active encapsulation of therapeutics; 2) modification of nanoparticles by receptors such as DNA aptamers; 3) the study of the interaction of the nanosystems with selected cell cultures. Study of nanoparticle internationalisation and cell viabilty

Študijný program / *Study programme:*
Biofyzika / *Biophysics*

Názov / *Title*
Účinky plazmy a plazmou aktivovanej vody na baktérie a rastliny
Effects of plasmas and plasma activated media on bacteria and plants

Jazyk záverečnej práce / *Language of Thesis*
anglický / *English*

Školiteľ / *Tutor*
doc. RNDr. Karol Hensel, PhD.

Anotácia / *Annotation*
Low temperature (cold) atmospheric plasmas generated by electrical discharges are efficient sources of radicals and reactive species and open up many new applications, especially in biomedicine and agriculture. As a result, multiple practical applications based on cold plasma discharges are now being developed, such as gas and water treatment, bio-decontamination and disinfection, surface cleaning, wound healing, potential cancer therapies, and stimulation of germination of seeds and plant growth. However, the exact mechanisms of the biological and chemical effects induced by cold atmospheric plasma discharges are still not fully understood. The plasma effects to bacteria, cells and tissues, or seeds and plants are often indirectly mediated through liquids, so called plasma activated water (PAW) or other media (PAM). Interaction of plasmas with liquids is a novel avenue of research, which greatly contributes to more complex understanding of the interaction of cold plasmas with complex biological systems.
Low temperature (cold) atmospheric plasmas generated by electrical discharges are efficient sources of radicals and reactive species and open up many new applications, especially in biomedicine and agriculture. As a result, multiple practical applications based on cold plasma discharges are now being developed, such as gas and water treatment, bio-decontamination and disinfection, surface cleaning, wound healing, potential cancer therapies, and stimulation of germination of seeds and plant growth. However, the exact mechanisms of the biological and chemical effects induced by cold atmospheric plasma discharges are still not fully understood. The plasma effects to bacteria, cells and tissues, or seeds and plants are often indirectly mediated through liquids, so called plasma activated water (PAW) or other media (PAM). Interaction of plasmas with liquids is a novel avenue of research, which greatly contributes to more complex understanding of the interaction of cold plasmas with complex biological systems.

Cieľ / *Aim*
The objective of the thesis would be: * investigation of gaseous discharges and cold plasmas, their interaction with water and formation of plasma activated water (PAW); measurements of reactive species in gas and PAW * investigation of effects of plasma and PAW on selected bacteria in aqueous solutions and on contaminated surfaces focusing on physiological processes (e.g. cultivability, sub-lethal damage, etc); degradation of selected biomolecules (proteins, enzymes, lipids) * investigation of effects of PAW on seed germination in vitro, growth and ontogenetic evolution of plants in vivo; evaluation of growth parameters, photosynthetic pigments and photosynthetic rate, total soluble protein content, and activity of antioxidant enzymes.
*The objective of the thesis would be: * investigation of gaseous discharges and cold plasmas, their interaction with water and formation of plasma activated water (PAW); measurements of reactive species in gas and PAW * investigation of effects of plasma and PAW on selected bacteria in aqueous solutions and on contaminated surfaces focusing on physiological processes (e.g. cultivability, sub-lethal damage, etc); degradation of selected biomolecules (proteins, enzymes, lipids) * investigation of effects of PAW on seed germination in vitro, growth and*

ontogenetic evolution of plants in vivo; evaluation of growth parameters, photosynthetic pigments and photosynthetic rate, total soluble protein content, and activity of antioxidant enzyme

Poznámka / *Comment*

The potential candidate should be an enthusiastic person with a solid knowledge and experience either in physics of discharges and plasmas, or experience in biophysics, medicine, and plant biology.

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Študijný program / *Study programme:*
Biofyzika / *Biophysics*

Názov / *Title*
Vyšetrovanie účinkov studenej plazmy a plazmou aktivovanej vody na imunokompetentné bunky
Analysis of the effects of cold plasma or plasma-activated water to immunocompetent cells

Jazyk záverečnej práce / *Language of Thesis*
anglický / *English*

Školiteľ / *Tutor*
doc. RNDr. Zdenko Machala, PhD.

Konzultant / *Consultant*
doc. RNDr. Ľubomíra Tóthová, PhD.

Anotácia / *Annotation*
Cold atmospheric plasmas generated by electrical discharges are efficient sources of radicals and reactive species. They produce strong oxidative environment and induce antimicrobial and cytotoxic effects in cells and tissues. These tissues can be targeted for elimination of infection or in cancer therapy. As a result, multiple applications based on cold plasmas are now being developed, such as water activation, bio-decontamination and sterilization, surface cleaning with impact in dentistry, disinfection, wound healing along with potential cancer therapies, or stimulation of germination and plant growth in agriculture. However, the exact mechanisms of the chemical and biological effects induced by cold atmospheric plasmas are still not fully understood. The plasma effects to cells and tissues are often indirectly mediated through liquids. These liquids are known as plasma-activated water (PAW) or plasma-activated media (PAM). Interaction of plasmas with liquids is a novel way/approach to research, and it greatly contributes to a more complex understanding of the interaction of cold plasmas with complex biological systems. Some recent works demonstrated the ability of cold plasmas to activate immunocompetent cells that are then more efficient in targeting e.g. tumors. Plasma-activated NETosis (neutrophil extracellular traps activation and release) represents a potential new way of stimulation of the immune system to fight infections.

Cieľ / *Aim*
The key objective is the analysis of activation of NETosis by cold plasma or PAW. Secondary objective is the description of ways of immunocompetent cells stimulation. • Experimental investigations and spectroscopic measurements of the aqueous species in water solutions activated by various types of plasma discharges, • In-vitro investigations of the effects of various types of plasma activated water on activation immunocompetent cells (neutrophils, monocytes, leukocytes) by determining TNF alpha, MPO and other inflammatory markers • In-vitro analysis of the effects of direct plasma activation of immunocompetent cells (neutrophils, monocytes, leukocytes). • In-vivo tests to investigate the effects of plasma stimulated immunocompetent cells in animal model of colitis, urinary tract infections or wound healing.

Literatúra / *Literature*
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2013 • Lin et al.: Non-Thermal Plasma as a Unique Delivery System of Short-Lived Reactive Oxygen and Nitrogen Species for Immunogenic Cell Death in Melanoma Cells, Adv. Sci. 2019, 6, 1802062 and other topic related journals

Poznámka / *Comment*

The potential candidate should be an enthusiastic person with a solid knowledge and experience with experimental physics and biology. He/she will work in the dynamic multi-disciplinary research group conducting studies at the frontiers of cold plasma science and medicine. The collaboration will be between Environmental Physics group of FMFI UK and Institute of Molecular Biomedicine of LF UK. Previous practical experience in working with non-thermal plasma is acknowledged. Laboratory research experience is required. The minimal requirements include a completed Master level degree in the intended area of study or a closely related area. The potential candidate should be an enthusiastic person with a solid knowledge and experience in experimental physics and biology. He/she will work in the dynamic multi-disciplinary research group conducting studies at the frontiers of cold plasma science and medicine. The collaboration will be between Environmental Physics group of FMFI UK and Institute of Molecular Biomedicine of LF UK. Previous practical experience in working with non-thermal plasma is welcome but not a condition. However, laboratory research experience is required. The minimal requirements include a completed Master level degree in the intended area of study or a related area. The topic is related to the ongoing project supported by Slovak Research and Development Agency (APVV): Interaction of cold plasma with water, the effects of plasma activated water to biological systems and their uses in medicine and agriculture

Kľúčové slová / *Keywords*

Cold plasma, plasma activated water, reactive oxygen and nitrogen species (RONS), immunocompetent cells, neutrophils, NETosis

Študijný program / *Study programme:*
Biofyzika / *Biophysics*

Názov / *Title*
Vývoj biosenzorov na detekciu antibiotík a baktérií v mlieku
Development of biosensors for detection of antibiotics and bacteria in milk

Jazyk záverečnej práce / *Language of Thesis*
slovenský / *Slovak*

Školiteľ / *Tutor*
prof. RNDr. Tibor Hianik, DrSc.

Konzultant / *Consultant*
Mgr. Marek Tatarko, PhD.

Anotácia / *Annotation*
Kvalita a bezpečnosť potravín je jednou z priorít Európskej únie. Vzhľadom na široké použitie antibiotík v živočíšnej výrobe dochádza ku kontaminácií mlieka a mliečnych výrobkov s možnými nežiadúcimi účinkami na zdravie ľudí. Potraviny môžu byť taktiež kontaminované patogénnymi baktériami. Súčasné štandardné metódy detekcie patogénov sú zdĺhavé a vyžadújú špecializované laboratóriá. Cieľom výskumu je vývoj nových metód na báze biosenzorov, ktoré by mohli byť použité na farmách a v potravinových laboratóriách. Doktorand sa oboznámi s metódami detecie antibiotík a baktérií pomocou elektrochemických a akustických metód na báze DNA aptamérov ako receptorov. Bude sa venovať zdokonaleniu citlivosti biosenzorov pomocou využitia rôznych nanoštruktúr. Bude sa podieľať na projekte podporenom v programe Horizont 2020 Európskej komisie.
Quality and safety of food is among the priority of European Union. Due to wide application of antibiotics in animal production the contamination of milk and dairy products took place with not desirable effect on the population health. The food can be also contamined by bacterial pathogens. Current standard methods of pathogen detection are time consuming and require specialized laboratories. The aim of the research is development of novel methods based on biosensors that can be used in dairy farms ads well as in food laboratories. The doctoral student will be introduced into the detection of antibiotics and bacteria by electrochemical and acoustics methods using DNA aptamers as receptors. The purpose of the thesis will be in improvement of the sensitivity of biosensors based on various nanostructures. The work will be conducted in framework of Horizon 2020 project supported by European Commission.

Cieľ / *Aim*
Dizertačná práca bude zameraná na vývoj biosenzorov na báze DNA aptamérov a nanoštruktúr takých ako oxid grafénu, uhlíkových nanorúrok a pod. na detekciu antibiotík a baktérií v mlieku. Na vývoj biosenzorov budú použité elektrochemické a akustické metódy.
The doctoral thesis will be focused on the development of biosensors based on DNA aptamers and nanostructures such as graphene oxide, carbon nanotubes etc. for detection antibiotics and bacteria in milk. For biosensors development the electrochemical and acoustics methods will be used.

Literatúra / *Literature*
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