

MOLECULAR CYTOLOGY

Application of carbon nanoparticles in hypericin-mediated photodynamic therapy

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study form: full time

Annotation: Nanoparticles are increasingly being studied for their interesting properties and potential exploitation in nano-oncology. The effectiveness of some anticancer drugs may be affected by decreased aqueous solubility, poor cell permeability, and high cell efflux. For this reason, various types of nano-drug carriers (e.g. liposomes, polymeric micelles, dendrimers, superparamagnetic iron oxide crystals and colloidal gold) have already been tested in practice to increase drug selectivity and thus minimize the side effects of anti-cancer drugs. A suitable subject in combination with nanoparticles appears to be hypericin, a natural photosensitizer, characterized by high production of oxygen radicals, but due to its hydrophobicity also reduced systemic availability. The aim of the dissertation thesis will be to find out whether the application of carbon-based nanoparticles is safe for a healthy cell and how the use of nanotechnology can influence the amount of hypericin and the effect of photodynamic therapy in tumour cells and micro-tumours.

Presensitization of cancer cells by activation of death receptor

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Annotation: Skyrin is a likely precursor in the synthesis of hypericin. Based on the similarity in the chemical structure, it is believed that, like photoactivated hypericin, it could inhibit tumour cell proliferation and induce cell death. Our preliminary results suggest that, in addition to its antiproliferative activity, skyrin induces DR5 death receptor expression not only under normoxic but also under hypoxic conditions. The aim of the dissertation thesis will therefore be to verify the potential of skyrin to activate the extrinsic apoptosis receptor pathway and to use it in favour of the subsequently applied experimental anti-tumour procedure.

Characterization of microenvironment in the subventricular zone of lateral ventricles of the brain in relation to neurogenesis

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study form: full time

Annotation: The main goal of the dissertation thesis is to analyze selected morphogens and growth factors bound in the fractones and their effect on the activity of surrounding cells (B-, C-, A- and E- cells) in the ventricular and subventricular zone of lateral ventricles of rat brain during the ontogenesis. Comparison of content of morphogens and growth factors bound in the fractones of non-neurogenic postnatal spinal cord, should reveal the identity of morphogens and growth factors, which have substantial impact on neurogenesis in lateral ventricles of brain.

The physiological and molecular adaptations of microorganisms to hypersaline environments

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Annotation: The study of extreme environments in recent years has led to interesting discoveries that have changed our view of the origin of life on our Earth but has also enabled the biotechnological use of microorganisms adapted to these environments. Extremozymes, enzymes from extremophilic microorganisms, are a completely new and promising area of modern biotechnology. In Slovakia as an inland country, the occurrence of extreme environments is significantly limited, and natural extreme environments are practically unexplored. The topic of the dissertation is primarily focused on the study of the microbiome of hypersaline (salt) springs in Slovakia and the isolation, microbiological and genetic characterization of halophilic microorganisms in these environments in order to identify new species of bacteria, characterize their genome and physiological and molecular adaptations to extreme environments. To better understand the molecular adaptations of selected extremozymes to high salinity, these will be overexpressed in heterologous hosts and the molecular dynamics and catalytic activity of proteins depending on the salinity of the environment will be studied.