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Nanomedicine and Nanotechnology

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4th World Biotechnology Congress

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Scientific Tracks & Abstracts

30 YEARS OF EXCELLENCE IN MEDICAL PUBLISHING

The future of medicine is now: Nanotechnology

Dammy Oshodi
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Many healthcare professionals are not aware of nanomedicine and how it can transform healthcare practices. Many are not given the opportunity to learn the basics of nanotechnology, specifically, in nanomedicine and how it can apply to their practices, businesses, and health. Th purpose of this presentation is to give an introduction of nanotechnology and a basic understanding of its various purposes in modern medicine. It will provide an understanding of the functionality and characteristics of nanoparticles and how these details can be manipulated to enhance nanoparticle functions in general therapeutic applications. This presentation will also examine current drugs on the market and future possibilities with nanomedicine. For instance, applications of nanoparticles towards regenerative medicine can improve tissue engineering and ease the effects of diseases like osteoarthritis. In addition, targeted drug delivery systems using nanomedicine can be a solution to current conventional drug delivery options. As healthcare professionals are introduced to new ideas and methods in nanomedicine, they can understand what's possible for their practice and provide the best care possible to their patients.

Conclusion & Significance: Many healthcare professionals are not aware of nanomedicine and its possibilities for the future of medicine. A basic understanding of nanotechnology on general therapeutic applications such as targeted drug delivery systems and regenerative medicine can transform current healthcare practices and provide professionals with tools to advance patient care.

Biography

Dammy Oshodi is a student at the University of South Florida, receiving her Masters in Pharmaceutical Nanotechnology. With a background in Biology and Communication Arts, Ms. Oshodi has made it her duty to make the complexities of science digestible to all people. Dammy is not only a student but the creator of a podcast and online community called The Plannter which focuses on helping millennials grow into the best version of themselves. She is also the owner and creator of Made For Nano, a platform that helps educate people on the importance of nanomedicine, create opportunities to network with other nanomedicine enthusiasts, and foster relationships to create greater collaborations within the field.

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Notes:

Plant-based strategies aimed at expressing a synthetic human adenosine deaminase at high levels

David Bringloe
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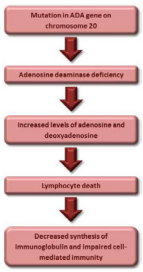
An inherited disorder, ADA deficiency is a form of severe combined immunodeficiency, which is ultimately caused by an absence of adenosine deaminase (ADA), a key enzyme of the purine salvage pathway. The absence of ADA-activity in sufferers eventually results in a dysfunctional immune system due to the build-up of toxic metabolites. To date, this has been treated with mixed success, using PEG-ADA, made from purified bovine ADA coupled to polyethylene glycol. It is likely however, that an enzyme replacement therapy protocol based on recombinant human ADA would be a more effective treatment for this disease. Therefore, as a preliminary step to produce biologically active, synthetic human ADA in transgenic tobacco plants and tobacco BY-2 cell suspensions a human ADA cDNA has been inserted into a plant expression vector under the control of the CaMV 35S promoter and terminator. In an attempt to maximise the yield various recombined gene constructs containing compartmental targeting sequences were tested along with different translational regulatory sequences, such as TMV omega and RUBISCO untranslated regions.

Tobacco plants and BY-2 cells transformed with cytosolic constructs showed levels of recombinant ADA of up to 97 ng mg-1 TSP. By comparison, transgenic calli expressing constructs containing apoplast-directing signals showed higher levels of recombinant ADA expression of up to 140 ng mg-1 TSP. The most significant ADA activities, however, were measured in the media of transgenic BY-2 cell suspensions prepared from transformed calli: where incorporation of a signal for arabinogalactan addition to ADA, led to a recombinant protein yield of approximately 16 mg L-1. A 336-fold increase over ADA produced by cell suspensions transformed with a cytosolic construct.



Biography

David Bringloe has completed his PhD and his current research interests involve heterologous gene expression systems and plant biotechnology, his main focus is to control of foreign gene expression in plants, particularly the production of therapeutic proteins and now also prions. To date, plant-based strategies have been employed to express various therapeutic enzymes and proteins at high levels in whole plants and plant cell suspensions.

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Notes:

The role of thioredoxin reductase in gold nanoparticle radiosensitization effects

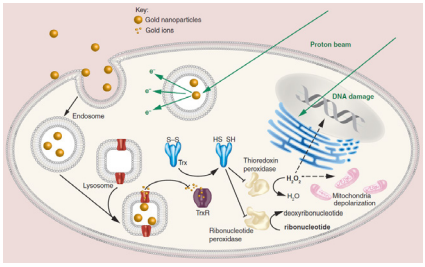
Sebastien Penninckx
University of Namur, Belgium

Aim: To identify new mechanisms responsible for the radiosensitization effect of gold nanoparticles (GNPs).

Materials & Methods: Five different cell lines were incubated with homemade 10 nm GNPs 24h before to be exposed to 25 keV/µm protons or 225 kV X-rays.

Findings: GNP incubation with lung carcinoma cells led to a time-dependent mitochondria membrane depolarization, oxidative stress and to X-ray and proton radiosensitization. Moreover, a marked inhibition of thioredoxin reductase (TrxR) was observed. Irradiation of cells invalidated for TrxR evidenced a radiosensitization effect, suggesting that this enzyme is a potential GNP target. Furthermore, we reported that this TrxR activity reduction is cell type-dependent and lead to differences in cell response to X-ray irradiation. Correlation analyses demonstrated that GNP uptake and TrxR activity inhibition are associated to GNP radiosensitization effect. Finally, Kaplan-Meier analyses suggested that high TrxR expression is correlated to low patient survival in four different types of cancer.

Conclusions: We suggest that GNPs play a radiosensitizer role by weakening detoxification systems. All together, these results enable a better understanding of GNP radiosensitization mechanisms which remain a mandatory step towards further use in clinic. Moreover, they highlight the potential application of this new treatment in a personalized medicine context opening up novel promising strategies for the development of nanotechnologies associated to radiotherapy.



Biography

Sebastien Penninckx got a master's degree in chemistry at Free University of Brussels (Belgium). He then defended his PhD thesis in physics and biology at University of Namur (Belgium) in February 2019. In recent years, he has built bridges between nanotechnology and biophysics in close collaboration with transdisciplinary teams in the research institute NARILIS in the UNamur. During his PhD thesis, he has spent 3 months at UC Berkeley (California, USA) and NASA Ames Research Center (USA) where he studied cancer risk prediction for astronauts exposed to ionizing radiations during spacecraft missions.

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Notes:

Development of versatile biological models to study nanodevices biomedical potential

Morgane Daurat
Institut des Biomolécules Max Mousseron, France

The development of personalized and non-invasive therapies based on new nanoparticles is a major challenge in medicine. In this context, we studied different nanoparticles for cancer therapy.

Firstly, we analyzed the biological efficiency of hollow organosilica nanoparticles. Porous systems are used to be applied to drug adsorption and delivery. In this case, we have loaded two anti-cancer drugs, which have been used to perform in vitro investigations in order to demonstrate their biocompatibility and their potential as drug carrier vehicles to treat cancer.

Moreover, nanoscience has grown considerably in cancer treatment with nanoparticles activated with stimuli as Mn2+-doped Prussian blue nanoparticles. They are many advantages as their flexible structure, porosity and biocompatibility. Indeed, Prussian blue has been approved by the Food and Drug Administration for human. We have demonstrated for the first time that these nanoparticles acted as efficient agents for photothermal therapy under Two-Photon Excitation (TPE) and induce an almost eradication of malignant cells.

Finally, in order to respond to increasing demand for new therapies, the Photo Dynamic Therapy (PDT) has arisen as an alternative to chemo- and radiotherapy for the non-invasive selective destruction of small tumors. PDT is based on photosensitizers activation by irradiation. To enhance the selectivity towards tumor cells and the efficiency of PDT, the photosensitizers are encapsulated in Periodic Mesoporous Organosilica (PMO) nanoparticles. To go further in the biomedical proof of concept of therapeutic nanoparticles, we are currently developing an animal model as Danio rerio (zebrafish) to study cancer. We have implanted fluorescent human cancer cells in zebrafish larvae in order to establish a detectable tumor xenograft. Then, we have intravenously injected PMO for TPE-PDT in zebrafish and irradiated the tumor site with a pulsed laser. The strong decrease in tumor size let us imagine developing such model to test the biomedical potential of different nanoparticles.

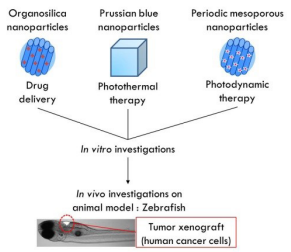

Figure 1: The design of multifunctional nanomaterials with controlled physico-chemical properties thanks to the chemistry expertise allow to the biologists to demonstrate their biomedical potential on *in vitro* and *in vivo* biological models.

Biography

Morgane Daurat is born in 1991 in Béziers (France). She is a PhD student in third year at Institut des Biomolécules Max Mousseron in Montpellier (France). She works on the development of biological models to study nanoparticles biomedical potential and on lysosomal diseases for the company NanoMedSyn (Montpellier, France). She is co-author of nine articles.

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Preliminary studies of the synthesis of gold nanoribbons based on the seed size

Joanna Patalas
Adam Mickiewicz University, Poland

Nanotechnology and medicine gave birth to the new and promising interdisciplinary research field called nanomedicine. Thanks to the improvements in both of the nanotechnology and nanomedicine we are able to help and improve people's health on the nanoscale. One way is using biosensors that can signalize the existence of pathogens, alien DNA, viruses etc.

The most important features of the nanomaterial to create a biosensor are their shape and stability. Shapes that are the best fit are elongated and flat nanoparticles such as nanotubes, nanorods, nanowires and nanoribbons. The size of these nanocreations gives an opportunity to later functionalize them with biological and chemical molecules.

Gold nanoribbons are promising metallic support for biosensors in the nanoscale, and thanks to the development of modern technology, we are able to create them using various methods. One of them is using oligomeric and polymeric surfactants – surface active agents, built of hydrophobic and hydrophilic moieties that can wrap around the growing nanoparticles. The properties of surfactants are helping to stabilize the growth of the specific shape of nanoparticle such as nanoribbons.

The conducted study has been focused on creation of metallic nanoribbons especially gold nanoribbons with the use of various surfactants. The gold seeds used in the synthesis of nanoribbons have been tested via UV-Vis. Later, properties of synthesized nanoribbons have been tested with Atomic Force Microscopy and Transmission Electron Microscopy. Relying on those spectroscopy and microscopy techniques we were able characterize created nanoparticles.

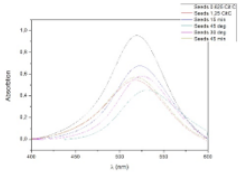

Figure 1 (left). Impact of the temperature, time and concentration of Na3Cit for the growth of nanoribbons.

Factor	Peak [nm]
0,625 ml Na3Cit	516
1,25 ml Na3Cit	513
Time 15 min	520
Time 45 min	520
Temperature 30°C	523
Temperature 45°C	530

Figure 2 (right). Peak value for each factor.

Biography

Joanna Patalas is a student of the 4th year of Medical Physics, Department of Macromolecular Physics, Faculty of Physics, University of Adam Mickiewicz. She and 3 other students under coordination of prof Maciej Kozak has been working on a project that improves ways of obtaining specific shape of nanoparticles with the use of oligomeric and polymeric surfactants. Her passion is working for the improvements in new methods of helping people such as nanomedicne and gene therapy.

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Notes:

Effect of various shapes of gold nanoparticles on growth on cancer and normal cells

Marika Musielak
Adam Mickiewicz University, Poland

Recently, particular attention has been paid to the advancements in nanomedicine and its various applications. Special focus is put on the use of nanoparticles (NPs) for cancer treatment. Wide range of morphological structures and the fact that NPs can be prepared from various kinds of metallic materials (e.g. gold or silver), can be a great advantage in nanopharmacy and theranostics.

The aim of our study was characterization of the influence of gold nanoparticles, modified by selected surfactants on the cancer and normal cell lines. The cancer MDA-MB-231, MCF-7, PC-3, LNCaP and normal PNT1A cell lines were used to check the cellular response. MTT assay (3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide) was used as cytotoxicity test of nanoparticles and surfactants used in the synthesis of NPs. Cell cycle arrestation in a given phase can be very important in application for various cancer therapies. An impact of nanoparticles on the cell cycle using flow cytometry was analyzed.

Performed experiment gave information about cytotoxicity of gold nanoparticles. Toxicity of GNPs strongly depends on the amount and type of surfactants used in their synthesis. Both, the cell viability and proliferation decreased with increasing concentration. Gold nanoparticles also affected the cell cycle of chosen cell lines. An experiment confirmed the fact that gold nanoparticles can become a promising tool in the cancer treatment. However, it is still necessary to extend the range of nanoparticle research to animal tests and clinical trials. This research project was supported by the programme Best of the Best (Najlepsi z Najlepszych) 3.0 from Ministry of Science and Higher Education (Poland).

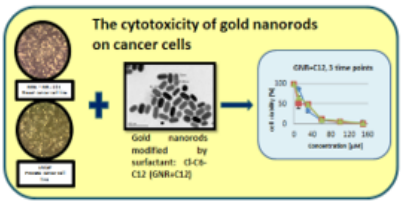

Figure 1: Scheme of the experiment carried out where gold nanorods were added to breast and prostate cancer cells. After a fixed incubation time, a large cytotoxicity effect was observed.

Biography

Marika Musielak is a student of Medical Physics at the Adam Mickiewicz University in Poznan, faculty of physics, department of macromolecular physics. She takes part in the project under coordination of prof Maciej Kozak, that works on creation of specified shapes of nanoparticles, that can be used for cancer treatment and nanobiosensors. Since her interests lays in cell biology science, she leads the work on the cell culture to determine the effects of nanoparticles on the cancer and normal cell lines. She is keen on innovative methods of oncological treatment.

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Development of galactosamine decorated andrographolide loaded nanocochleates for liver cancer targeting

Bothiraja Chellampillai
Poona College of Pharmacy, India

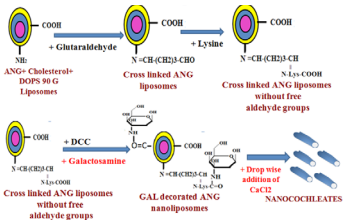
Statement of the Problem: Andrographolide (ANG), an anticancer chemotherapeutic phytoconstituent has been used in the treatment of various tumours and produced 39% inhibition cancer cell due to lack of specific affinity for site of action or to its limited biopharmaceutical properties. This juncture demands an effective, controlled release and safe formulation of AND would be a significant advance for the treatment of cancer. Nanocochleates are unique lipid-based supramolecular assemblies composed of a negatively charged phospholipid and a divalent cation. Aim of the study was to develop galactosamine (GA) decorated andrographolide (ANG) loaded nano-cochleates (NC) for liver targeting.

Methodology: GA was attached to ANG-loaded 1,2-dioleoyl-sn-glycero-3-phospho-L-serine (DOPS) nanoliposomes (GA-ANG-NL) by aldehyde chemistry. GA-ANG-NL was converted into nanocochleates (GA-ANG-NC) by addition of Ca2+ ions and evaluated in terms of in-vitro and in-vivo and compared with ANG and ANG-NC.

Findings: ANG-NC and GA-ANG-NC showed particle size of 149 and 835 nm and zeta potential of -0.308 and -2.08 mV, respectively. ANG-NC and GA-ANG-NC showed higher release in pH 5.3 as compared to pH 7.4. GA-ANG-NC demonstrated higher in-vitro anticancer activity in Human hepatoma cell line Hep-G2. The targeting effect for the GA-ANG-NC was also demonstrated in which fourfold improved GI50 as compared ANG. Moreover, bioavailability of AGN from GA-ANG-NC increased by 3-fold with long circulation time and slower plasma elimination. Furthermore, GA-ANG-NC showed 2.1-fold increases in liver drug concentration ANG.

Conclusion & Significance: The proposed strategy is advantageous in terms of targeted drug delivery and has high potential to address the current challenges in drug delivery. Thus, the prepared nanocarrier offers a novel formulation that combines the unique properties of a biodegradable material, galactosamine and nanocochleates for biomedical applications.

Acknowledgement: The authors sincerely acknowledge Lipoid GmbH, Ludwigshafen, Germany for providing gift sample of1,2-dioleoyl-sn-glycero-3-phospho-L-serine (DOPS).



Biography

Bothiraja has expertise in the field of novel and targeted drug delivery systems. His rigorous research work has been dedicated in various research projects like nanoparticulate systems drug delivery, tumor targeting, solid dispersion and crystal engineering. He has 50 research papers published in various international and national journals depict quality, innovativeness and expertise achieved by him in mentioned research fields. He would also like to use his enthusiasm for science to involve students and help them to become successful and contributing members of the scientific community.

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Highly stable *E. coli* –expressed humanized anti-EGFR scFv

Kamal Veisi
Shahid Beheshti University of Medical Sciences, Iran

In the current work, we show how to design an intrinsically stable single chain antibody (scFv) that can be easily produced in bacterial expression systems as a soluble protein. Summarily, CDR loops are grafted on intrinsically stable framework regions derived from VH3 and VL3 human germline sequences. Human VH3 and VL3 candidates should carry CDR loops with desired canonical classes and contain special residues in their hydrophobic cores. Recombinant variable fragments resultant from CDR grafting are subjected to 3D modeling, mutated (if necessary), and superposed to parental variable domains. Recombinant type 3 variable domains with the least RMSD (Root-Mean-Square Deviation) values are chosen to constitute scFv moieties. The scFv designed using this method was shown to be soluble when expressed in bacterial cells and able to recognize EGFR-overexpressing cancer cells.

Biography

Kamal Veisi has completed his PhD degree in medical biotechnology. He is an Assistant professor of Shahid Beheshti University of Medical Sciences and Kermanshah University of Medical Sciences, his research interest is antibody engineering.

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Young Research Forum

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Waste Vs Cancer: An innovative biomedical approach

Ram Kumar Ganguly
Vidyasagar University, India

Vermitechnology involves vermiculture and vermicomposting process which emerged as a comprehensible and lucrative technology for management of organic wastes. During vermicomposting, waste materials while passing through the earthworms gut are homogenized in a highly bacterial rich environment into a highly mineralized chemical forms. The present study reflects compost as an incubator of different beneficial bacteria which opens up a new vista not only in vermitechnology but also its biomedical significance. A significant turnover of different enzymes such as leucine arylamidase, β-Glucosidase, Urease and α-celulase supported further by FT-IR analysis represents a changeover in compost. The bacterial metabolic products allied with earthworms have an exclusive physicochemical pre-eminence as a facilitator of apoptosis (programmed cell death in a MCF-7 cell line). Five strains of bacteria were isolated and identified using 16srRNA sequencing. The ethyl acetate extract of one of the bacteria Bacillus anthracis have been undertaken which show a significant anticancer and antioxidant activity. Antioxidant activity revealed through DPPH radical scavenging assay show a maximum effect of (75.79 ± 5.41%) at 900 µg ml-1 concentration of the extract. Furthermore, a significant decrease in SOD and LDH activity were noticed upon application of extract. MTT assay showed a potent cytotoxic activity against MCF-7 cell line with an IC50 value of 46.64 ± 0.79 µg ml-1. Apoptosis was further confirmed through the nuclear fragmentation and DNA fragmentation analysis. Western blot analysis represents a down regulation of Akt protein, phosphorylated FOXO proteins. Increase of SOD activity along with decrease of Akt level reflects that the mode of action is entirely PI-3K dependent. It indicates that B. anthracis isolated from vermicompost could be potentially explored for the development of new therapeutic agents, especially against cancer. It will definitely open up a new vista in the area of waste management and bio-medical innovations.

Biography

Ganguly R.K. has completed Master of Science from Banaras Hindu University, India and had qualified several fellowship programs like CSIR-JRF, ICMR-JRF, GATE-JRF and SET JRF. He is now conducting the research work from Vidyasagar University and published a couple of international journals in different fields of biotechnology.

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30 YEARS OF EXCELLENCE IN MEDICAL PUBLISHING

The power of biomimetic nanoparticles

Dammy Oshodi
University of South Florida, USA

Many healthcare professionals are not aware of nanomedicine and how it can transform healthcare practices. Many are not given the opportunity to learn not only the basics of nanotechnology but innovative nanomaterials that are enhancing drug delivery. The purpose of this presentation is to give an introduction to biomimetic nanoparticles and a basic understanding of their functions and how they are enhancing the practice of nanomedicine. It will provide an understanding of the functionality and characteristics of biomimetic nanoparticles how these details can be manipulated to enhance nanoparticle functions in drug delivery, specifically in diseases that cause inflammatory responses. This presentation will also examine the advancement of nanoparticles. For instance, the reduction of immune responses towards nanoparticles, improved targeting efficiency and easier penetration through endothelial monolayers and tumor cells. As healthcare professionals are introduced to the idea of biomimetics, participants are able to engage in interactive activities with other attendees to solidify the material.

Conclusion & Significance: Many healthcare professionals are not aware of nanomedicine and new advancements within the field. A basic understanding of biomimetics as a targeted drug delivery system can increase the knowledge of attendees on nanomedical practices and provide professionals with tools to advance patient care.

Biography

Dammy Oshodi is a student at the University of South Florida, receiving her Masters in Pharmaceutical Nanotechnology. With a background in Biology and Communication Arts, She has made it her duty to make the complexities of science digestible to all people. Dammy is not only a student but the creator of a podcast and online community called The Plannter which focuses on helping millennials grow into the best version of themselves. She is also the owner and creator of Made For Nano, a platform that helps educate people on the importance of nanomedicine, create opportunities to network with other nanomedicine enthusiasts, and foster relationships to create greater collaborations within the field.

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