HORIZON 2020

NANOTHER

Advanced theranostic approach in cancer combining photodynamic therapy and nanoparticles

PROGRAM

HORIZON 2020, M-ERA.NET, Topic 5 *"Tailoring of bioactive material surfaces for health applications"*

PROJECT DURATION

01.07.2016 – 30.06.2019

USEFUL LINKS

M-ERA.NET **https://m-era.net/**
University of Lisbon **https://www.ulisboa.pt/en/**
"Victor Babeș" National Institute of Pathology **http://www.ivb.ro/v2/index.php/en**
University of Medicine and Parmacy "Carol Davila" **http://www.umf.ro/**
Institute of Physical Chemistry, Romanian Academy **http://www.icf.ro/**
Autonomous University of Madrid, Faculty of Medicine, **https://www.bq.uam.es**
SC BIOTEHNOS SA **http://www.biotehnos.com/**
DOKUMAR **http://www.dokumar.com/en/index.html**

PROJECT SUMMARY

Theranostics is an emerging medical concept, combining imaging and therapy for personalized medicine. Considering the need for highly targeted therapy in cancer, the main objective of the project is the development new tools for one step imaging and therapy directed towards tumors (theranostic approach). Taking advantage of the huge biomedical potential and versatility of nanoparticles (NPs) and of fluorescent porphyrins as photosensitizers (PSs), we will bring improved joint power by designing, producing and characterizing porphyrin/biopolymer-coated iron oxide NPs, exhibiting superior imaging and photodynamic properties in solid tumors. As secondary objectives, 1) we will build a multidisciplinary

network in the field of nanotheranostics; 2) to train and to sustain career development for young researchers; 3) to obtain scientific and economic advantages for partner institutions, both academia and SMEs. The project is in line with the M-era.Net topic "Tailoring of bioactive material surfaces for health applications" by developing a new/improved (nano)solution with multifunctional properties for theranostics in cancer. It will be demonstrated at preclinical level (*in vitro* and *in animal models*), addressing both therapeutic efficacy and toxicological issues. We will start the project at TLR 1 – basic principles observed, advancing through TRL 2 – technology concept formulated, and TRL 3 – experimental proof of concept, towards TRL 4 – technology validated in lab, at the end of the project. The project is proposed by a multidisciplinary consortium composed of 3 universities, 2 research institutes and 2 SMEs from Portugal, Spain, Turkey and Romania. Partners will benefit from high level joint research and will share state-of-the-art technologies and know-how. Activities will be organized in 8 WPs: WP1-Porphyrins, WP2-Nanoparticles and nanosystems, WP3-Structural characterization of nanosystems, WP4 Photochemical characterization of nanosystems, WP5-Preclinical study, WP6-Mechanistic study, WP7-Dissemination and technology transfer, WP8-Management. Main deliverables: 1) Porphyrinic compounds and biocompatible functionalized nanosystems with antitumor activity and acceptable side-effects, comprehensively characterized from the physicochemical, photophysical and preclinical points of view; 2) therapeutic targets for improving photodynamic therapy by modulating the antioxidant response; 3) technical specifications and procedures for all the investigated compounds /nanostructures; 4) study-specific biobank, that will further allow the consortium to continue research beyond the project's frame; 5) improved protocols for preclinical investigation of nanostructures; 6) patent request documentation (at least 1); 7) documentation for pre-registering of at least 2 porphyrinic compounds at the European Chemicals Agency; 8) publications in high impact journals (at least 6) and result communication at relevant international congresses (at least 10); 9) training and exchange of young scientists in the field of nanotechnology and experimental medicine (at least 8); 10) organization of at least 2 workshops (industry showcase). The market strategy is to patent at least 1 nanosystem and to promote the patent to the pharmaceutical/nanotechnology industries after project completion. The new nanosystems and technologies which will be generated by the current project represent the premise for a future large-scale project joining

pharmaceutical/nanotechnology industry and academic research. Additionally, this project represents a good opportunity for young researchers to get specialized and to grow in a competitive research area. The success of the project is supported by the recognized expertise of the participating scientists, their previous fruitful cooperation and the commitment to apply material science for developing biomedical applications.

RESULTS

1. *Tetrapyrrolic compound with theranostic applications and obtaining process.* Patent application no. a 2016 00922/BOPI 6/2017, R. Boscencu, G. Manda, R. P. Socoteanu, M. E. Hinescu, N. Radulea, I. Neagoe, L. F. Vieira Ferreira.

2. *Porphyrin derivative for theranostic use.* Patent application no. a 2017 01030/5.12.2017, R. Boscencu, G. Manda, R. P. Socoteanu, M. E. Hinescu, I. Neagoe, L. Olariu, B. Dumitriu.

3. *Studies on the synthesis, photophysical and biological evaluation of some unsymmetrical meso-tetrasubstituted phenyl porphyrins,* R. Boscencu, G. Manda, N. Radulea, R. Socoteanu, L. C. Ceafalan, I. V. Neagoe, I. F. Machado, S. H. Basaga, L. F. V. Ferreira, Molecules, 22, 1815, doi:10.3390/molecules22111815**,** 2017, (I.F.= 2.861).

4. *New A_3B porphyrins as potential candidates for theranostic. Synthesis and photochemical behaviour,* R. Boscencu, R. P. Socoteanu, G. Manda, N. Radulea, M. Anastasescu, A. Gama, I. Ferreira Machado, L. F. Vieira Ferreira, Dyes and Pigments, 160, 410-417, https://doi.org/10.1016/j.dyepig.2018.08.028, (I.F.= 3.767).

5. *Unconventional evaluation of some promissing A_3B porphyrinic type compounds as theranostic agents,* R. Socoteanu, R. Boscencu, G. Manda, M. Anastasescu, L. F. Vieira Ferreira, 44thAnnual International Congress of Oncology and Markers, ISOBM, Rio deJaneiro, Brazilia, 2017.

6. *Effect of interaction with micellar media on spectral properties of some amphiphilic porphyrins.* R. Boscencu, R. Socoteanu, V. Nacea; L. F. Vieira Ferreira, 3rd Int. Electron. Conf. Med. Chem., 1–30 November 2017; Sciforum Electronic Conference Series, Vol. 3, 2017; doi:10.3390/ecmc-3-04693.

7. *Eco-friendly features in long-chain studies for pharmaceutical tetrapyrroles formulation targeting efficient drug delivery*, R. Socoteanu, R. Boscencu, M. Anastasescu, N. Radulea, I. Ferreira Machado, L.F. Vieira Ferreira, 9th world Congress on Green Chemistry and Technology, Amsterdam, 17-19 September 2018; abstract in Journal of Environmental Analytical Chemistry, 5, 80, doi:10.4172/2380-2391-C2-006, 2018.