Biosensing platform for lectin detection using nanoplasmonics

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INTRODUCTION

The Marie Curie ITN NanoCarb project combines nanotechnology and glycoscience to develop glyco-nanoparticle composites for applications in advanced nanomedicine. Exploring this currently underutilized and unexploited interface has the potential to deliver enhanced therapeutic and diagnostic technologies for a range of clinical applications, offering reduced cost and improved outcomes.

NanoCarb is a European Training Network comprising academic institutions, research centers and industry partners to train a new generation of creative and innovative multidisciplinary researchers in the fields of nanotechnology and carbohydrate chemistry. It brings together 15 Early Stage Researchers and the multidisciplinary expertise of 18 organizations from private and public sectors located in 9 European countries.

AIM

In this study we aim to develop gold nanorods (GNRs) conjugated with synthetic glycopolymers as a diagnostic biosensing platform for lectin detection.

Gold Nanorods (GNRs) are a promising platform for label-free biosensing in liquid biopsies: the localized surface plasmon resonance (LSPR) signal generated by GNRs is shape- and size-dependent, and is highly sensitive to refractive index changes in the local environment such as those caused by binding of biomolecules to the rod surface.

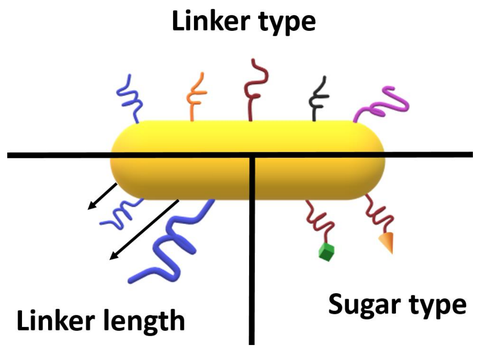
Glycan-lectin interactions are involved in many biological processes. Lectins recognize and bind specific carbohydrate moieties of glycoconjugates, and can be used as potential biomarkers for early detection, diagnosis and prognosis of human diseases.

Early studies reported that lectins, such as C-type lectins and ficolins, are involved in major vascular diseases such as ischemic stroke and myocardial infarction. Cerebro- and cardiovascular diseases are the leading cause of death and disability worldwide.

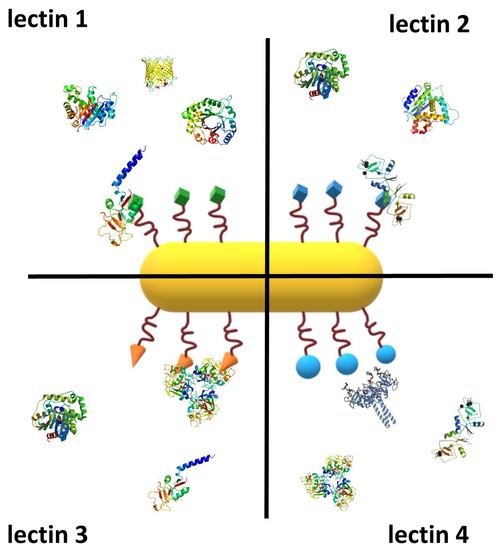
MATERIALS AND METHODS

- Selection of optimal linker strategy
  ^{1}H-NMR, ^{19}F-NMR, GPC-SEC
- Synthesis and conjugation of glycopolymers
  ^{19}F-NMR, IR
- GNR-bioconjugate characterization
  UV-Vis, DCS, NTA, DLS, Z-Potential
- Assessment of glycopolymer-lectin binding properties
  UV-Vis, DCS, NTA, Chip-based SPR
- Selection of the most effective lectin-glycan interaction
  Chip-based SPR, fluorescence-based techniques
- Optimized glycan-GNR LSPR technology verified in human serum
  UV-Vis

RESULTS

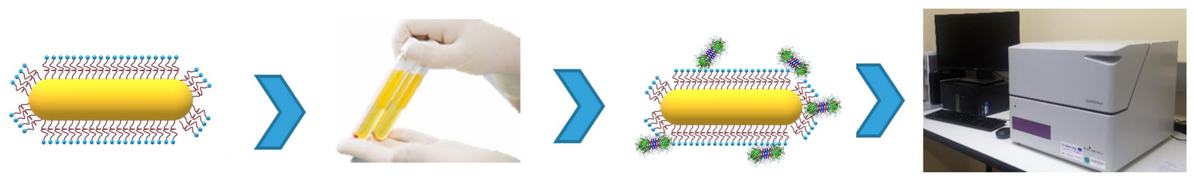


Setting up the methods for glycan-conjugation of GNRs and their characterization, to prepare a panel of different, high-quality GNR-glycan combinations.

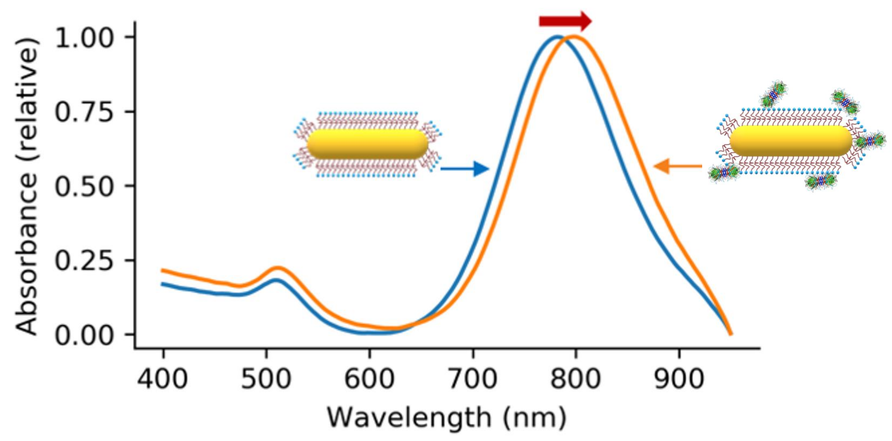


Assessment of the lectin binding properties

Overview scheme of the final assay



- Bioconjugation of gold nanorods
- Characterization
- Sample addition
- Incubation
- Lectins detection
- Assay read-out
- Data analysis



Red-shift of LSPR absorption observed when lectins bind glycoconjugated GNRs. The blue line is the absorption spectrum of glycopolymer-functionalized GNRs, the orange line shows the LSPR shift upon binding to lectin.

ACKNOWLEDGEMENTS

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 814236.