NANOMUG: MUCOSOMES, A NOVEL GLYCOSYLATED PROTEIN BASED DRUG DELIVERY SYSTEM

Cosmin Stefan Butnarasu[1], Giuseppe Guagliano[2], Francesco Bracotti[2], Paola Petrini[2], Livia Visai[3] and Sonja Visentin[1]

www.nanomug.it

[1]Department of Molecular Biotechnology and Health Sciences, University of Torino-IT
[2]Department of Chemistry, Materials and Chemical Engineering "Giulio Natta", Politecnico di Milano-IT
[3]Molecular Medicine Department UdR INSTM, University of Pavia, Pavia - IT

Correspondence sonja.visentin@unito.it

Nano Innovation 2021 Rome, 21-24 September Conference & Exhibition

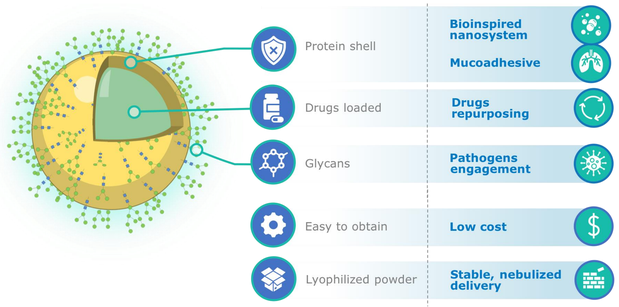
Abstract

- **NanoMug is a multivalent platform for drug delivery developed by NanoMuG.**
- **NanoMug is a patented technology that could be considered a new class of nanoparticles, defined as *MUCOSOMES* made of glycoproteins with mucoadhesive properties, specifically advantageous for the delivery/interaction with mucus, although not limited to this**
- **Different classes of drugs and molecules could be entrapped**
- **Bacterial and viral engagement by glycan-mediated binding**
- **Glycan-mediated cancer cell recognition**

Background

Glycans are involved in fundamental aspects of cell and organismal biology, such as the receptor-mediated cell to cell interactions that underline both normal and pathological processes. Glycosylation has three broad functions. First, some glycans form structures with unique physical properties. Second, glycans can regulate the function or properties of the entity to which they are attached, for instance by controlling protein stability or receptor dimerization. Last, certain glycans are themselves ligands for lectins, which are carbohydrate-specific receptors. **NanoMug can act as glycomimetic drugs with different action sites and pharmaceutical activities**

Advantages



Acknowledgements

Synthesis & characterization

NanoMug is synthetized by **a patented technology** starting from mucin proteins.

The one-pot synthesis method is developed at laboratory scale and allows to obtain amounts of NanoMug up to grams. However, it is assumed that the synthesis is easily suitable for industrial scale-up.

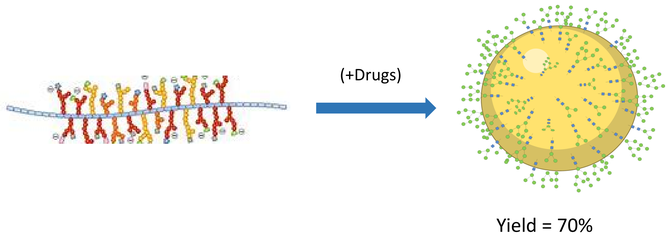


Figure1. Synthesis of NanoMug

It was demonstrated by spectroscopic techniques (TEM, FESEM, DLS) that NanoMuG nanoparticles are spherical, have nanometric size (ca 170 nm) and EDS analysis demonstrates that they are constituted by C, O, N and H.

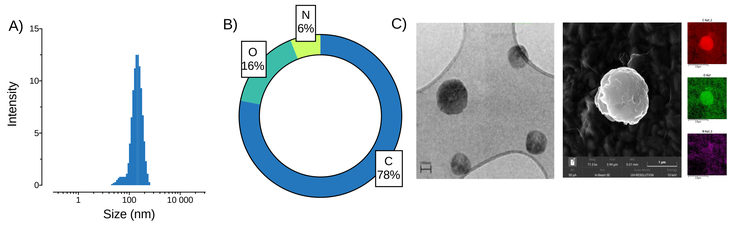


Figure2. Characterization of NanoMug: A) Dynamic Light Scattering; B) EDS; C) TEM and FESEM

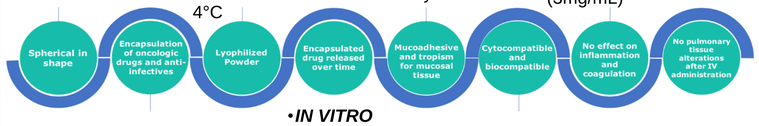
Development stage

NanoMuG synthesis and characterization

NanoMuG is suitable for lyophilization procedure and stable for 6 months at 4°C

Using a QCM test it was proved that NanoMug are mucoadhesive and remain attached to a mucin layer

- The effect of NanoMuG nanoparticles on IL-6, IL-b1 or absent (TNFα) uo to 5µg/mL
- NanoMuG does not alter the coagulation process (3mg/mL)



NanoMuG can be efficiently loaded with **new** or existing drugs (**repurposing**)

- ***IN VITRO***
NanoMuG nanoparticles demonstrated cytocompatibility on three different cell lines (HeLa, Vero, Hep2, macrophages)
- ***IN VIVO***
NanoMuG is highly biocompatible. After IV administration, mice remained healthy, no alteration of clinical parameters was observed, after 14 days of observation

Loading

The unique features of NanoMug may be transversally applied in different healthcare fields (bacterial & viral infections, oncology, ophthalmology, respiratory diseases, inflammatory diseases, vaccines, molecular imaging), thus, at the beginning it has been performed a preliminary market research on specialist HCPs/KoLs (Pneumologists, Oncologists, Gastroenterologists, Geriatrics, General Practitioners) and healthcare industry experts (Scientists; Commercial Pharma professionals; National Biotech Association board member) to investigate the potential of the patented technology and to understand the field of application.

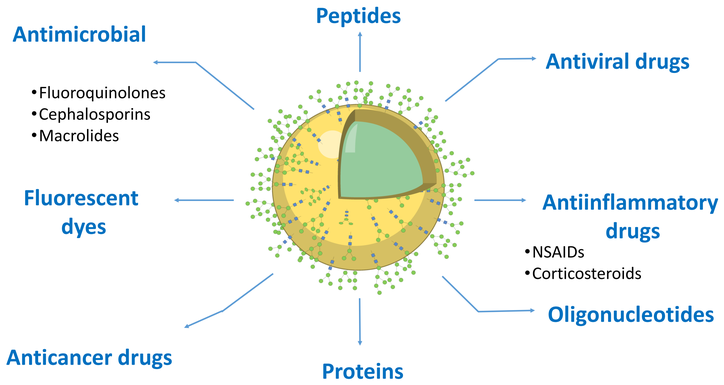


Figure3. Different molecules were entrapped in NanoMug with a range of entrapment efficiency (EE) of 18% to 85% .The EE was measured by LC-HRMS and UV-vis

Applications

For both bacterial and viral infections, demonstrate to have a dual action with a "**trap and kill**" characterized by:

Tested on virus : Sars-Cov-2

Tested on bacteria: *P. aeruginosa* *S. aureus*

The NanoMuG mechanism while repurposing chemotherapies can be summarized in three steps:

Tested on cancer cell lines: H358, H2030, 1792