Design and Characterization of pH-Responsive Lipid Self-Assemblies Against Bacterial Infections

Parth Kadakia[1], *Jules Valentin*[1], *Samuel Watts*[1], *Stefan Salentinig*[1]
[1]Department of Chemistry, University of Fribourg, Chemin du Musée 9, 1700 Fribourg, Switzerland;
email: parth.kadakia@unifr.ch

Treatment of bacterial infections at acidic pH (pH 5.0) is a growing challenge worldwide [1] . A promising approach is the design of lipid-based antimicrobial nanomaterials [2]. Herein, the design of a stable, non-toxic, and pH-responsive antimicrobial nanocarrier for treating bacterial infections at pH 5.0 is reported (**Figure 1**). The nanomaterial is formed by integrating rhamnolipid (RL) with glycerol mono-oleate (GMO). The pH- and composition responsive colloidal structures in the RL/GMO self-assemblies are demonstrated using small-angle X-ray scattering and cryogenic transmission electron microscopy techniques. The structures evolved from *Im3m* cubic to sponge, uni-lamellar vesicles, multi-lamellar vesicles, and elongated rod-like vesicles in these nanomaterials. *In vitro* biological assays demonstrated the antimicrobial activity of RL/GMO against *Staphylococcus aureus* at acidic pH (pH 5.0) and their cytocompatibility towards human dermal fibroblast cells. The RL/GMO also showed improved stability for one month. The results from this study outline a promising strategy for the comprehensive design of sustainable, antimicrobial, stable, and biocompatible pH-responsive lipid-based nanomaterials with potential applications as advanced wound-treating materials.

Keywords: pH-responsive lipid-based nanomaterial, antimicrobial, biocompatible, stable.

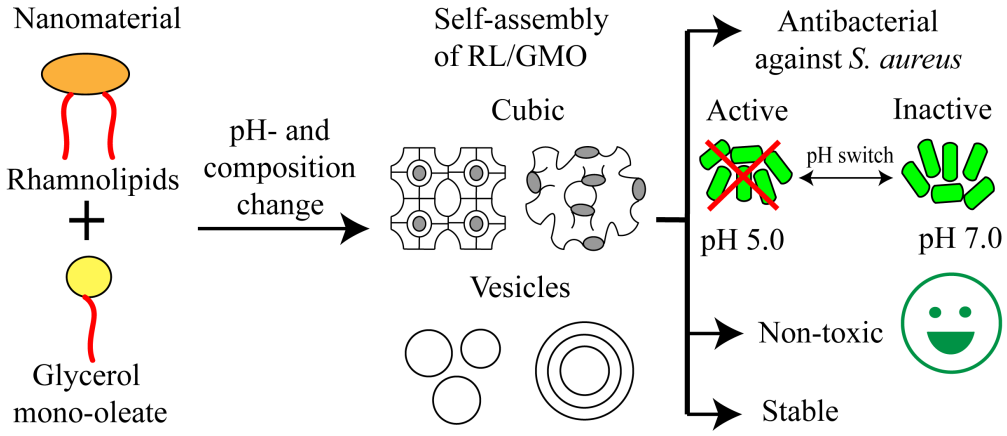

Figure 1. Nanomaterial composed of RL/GMO self-assemblies active against bacterial infections at pH 5.0.

References:

1. Grossi, A.P., et al., *Skin infections in Europe: a retrospective study of incidence, patient characteristics and practice patterns.* International Journal of Antimicrobial Agents, 2022. **60**(3): p. 106637.
2. Salentinig, S., *Supramolecular structures in lipid digestion and implications for functional food delivery.* Current Opinion in Colloid & Interface Science, 2019. **39**: p. 190-201.