



Development of new lipopeptide green surfactants from silk sericin

Rémi Bascou, Aurore Flick, Lara Wehbe, Erwann Guénin, Alla Nesterenko

► To cite this version:

Rémi Bascou, Aurore Flick, Lara Wehbe, Erwann Guénin, Alla Nesterenko. Development of new lipopeptide green surfactants from silk sericin. Formula XI, Jul 2023, Lille, France. hal-04206864

HAL Id: hal-04206864

<https://hal.science/hal-04206864>

Submitted on 1 Oct 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Development of new lipopeptide green surfactants from silk sericin

Rémi BASCOU¹, Aurore FLICK¹, Lara WEHBE¹, Erwann GUENIN¹, Alla NESTERENKO¹

Université de Technologie de Compiègne, ESCOM, TIMR (Integrated Transformations of Renewable Matter),
Compiègne, France – alla.nesterenko@utc.fr

The production of environmentally sustainable amphiphilic molecules constitutes one of the major issues of the surfactant industry, because of the pressure from regulatory legislation and growing consumer trend towards environmentally-friendly chemicals. Natural-based surfactants are mainly produced from agricultural food biomass such as sugars, starches, vegetable proteins and oils. However, these high-quality fractions of biomass are in competition with food and feed industries, which gives rise to ethical, environmental and political concerns due to the rapid growth of the world population¹. In this context, the development of new eco-friendly surfactants, derived from non-food silk proteins can represent an important challenge. Silks derived from silkworms are composed of two fractions: fibroin (~70%) used in textile industry, and sericin (~30%) removed by the degumming process during silk fibers production^{2,3}. Sericin is an undervalued protein, which use in the development of amphiphilic molecules has been little studied to date.

The main goal of this study is to develop an original way for silk sericin valorization to produce lipopeptide amphiphiles and to evaluate their adsorption properties. The first step involves the separation of sericin and fibroin fractions⁴. Then, sericin peptides are obtained by enzymatic hydrolysis. Finally, the grafting of hydrophobic functions on peptides *via* primary amino groups is performed. For this last step two methods of peptide functionalization were studied: conventional Schotten-Baumann acylation with fatty acid chloride in aqueous medium, largely applied on industrial scale, and new alternative approach using mechanochemical methodology for fatty acid grafting in solventless conditions. The surface activity and self-organization of obtained lipopeptides were investigated by surface tension measurements (Fig 1).

Results obtained showed that sericin can be successfully hydrolyzed using Alcalase enzyme with the hydrolysis degree (DH) between 20 and 50%. The grafting of hydrophobic chain of various length (C₁₀, C₁₂, C₁₄) to sericin peptides by conventional method was performed with acylation rate (ratio of grafted terminal *N*-functions) from 27 to 42%. Overall, the acylation rate was not significantly influenced by fatty acid chain length. Moreover, the results of solvent-free grafting of fatty acid on sericin peptides by mechanochemistry showed very promising results with comparable rate of functionalization. Lipopeptides produced from silk sericin showed good surface-active properties with significant lowering of water surface tension and the existence of a critical concentration for micelle formation.

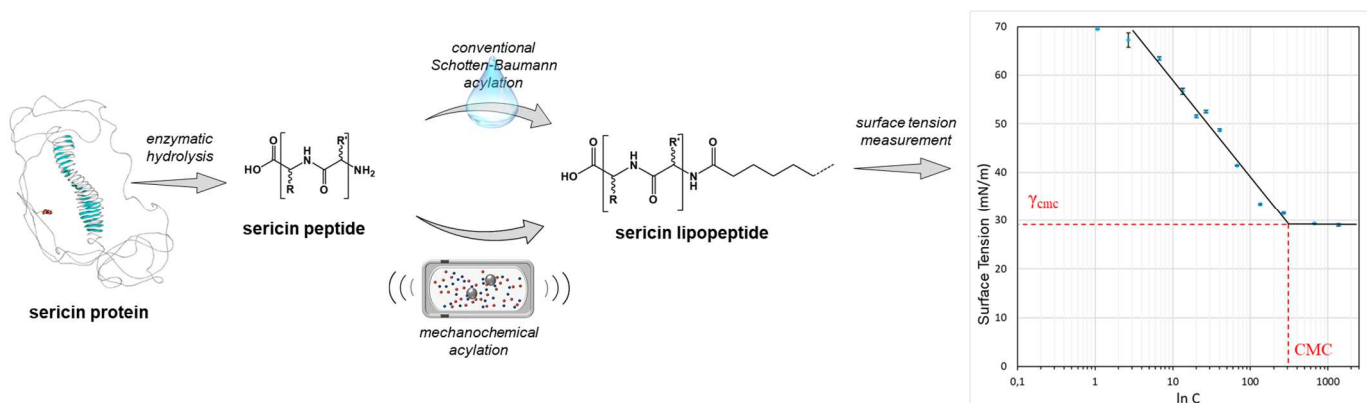


Fig 1. Methodology used for silk sericin-based lipopeptides' production

References

- Clark J.H., Green Chemistry, 2019, 21, 1168-1170. <http://dx.doi.org/10.1039/C9GC90021G>
- Vepari C.& Kaplan D.L., Prog Polym Sci, 2007, 32, 991-1007. <https://doi.org/10.1016/j.progpolymsci.2007.05.013>
- K.M. Babu, Silk, 9-By-products of sericulture and the silk industry, Woodhead Publishing, 2019, 207–233.
- Bascou R. et al., Mater Today Com, 2022, 33, 104491. <https://doi.org/10.1016/j.mtcomm.2022.104491>