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Synthesis of new lipopeptide green surfactants from silk by mechanochemistry

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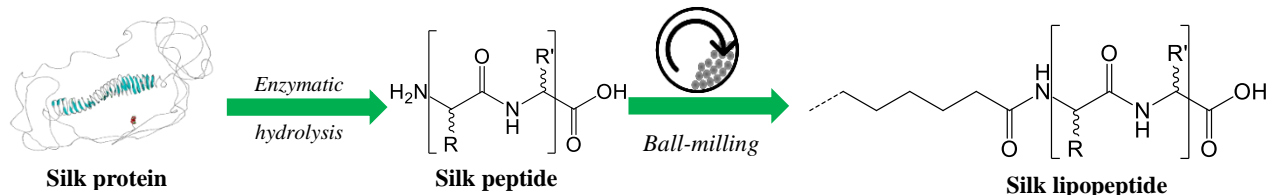
ABSTRACT

The production of environmentally sustainable amphiphilic molecules from natural origin constitutes one of the major issues for different industries due to the pressure from regulatory legislation and growing consumer trend towards environmentally-friendly chemicals. Natural-based surfactants can be produced from agricultural biomass such as sugars, starches, vegetable proteins and oils. However, these high-quality fractions of biomass are in competition with food and feed industries.¹

In this context, the development of surfactants from silk proteins as a nonfood biomass represents an interesting alternative. Silk is a biopolymer produced by different varieties of silkworms. Mulberry silk is obtained from the silkworm *Bombyx mori* L., it is composed of two kinds of proteins: fibroin (~70%) a fibrous protein, that imparts mechanical strength to the cocoon, used in textile industries and sericin (~30%), a glue-like protein, that binds the fibroin fibers together in a cocoon. Sericin is eliminated by a degumming process during the production of silk fibers.²

The main objective of this work is to develop an original synthesis to produce amphiphilic lipopeptides from silk and evaluate their surface activity. The first step involves the separation of the two fractions of silk: fibroin and sericin.³ Then, fibroin and sericin peptides are obtained by enzymatic hydrolysis. Finally, the grafting of the hydrophobic chain onto the silk peptides is carried out using a novel mechanochemical approach. The adsorption properties of the peptides and lipopeptides obtained are studied by surface tension measurements.

The obtained results show that the two silk protein fractions can be hydrolyzed using Alcalase with a degree of hydrolysis varying between 20 and 40%. The grafting of a fatty chain (C14) was optimized on model amino acids under solvent-free conditions by mechanochemistry, then it was extended to silk peptides. The acylation rate (ratio of grafted amine functions) was estimated by NMR and by UV spectroscopy (reactivities of primary amines) and this methodology gives promising results. The synthesized lipopeptides show a good surface activity and ability to reduce the air/water surface tension. Finally, fibroin peptides and lipopeptides show better surface activity than those of sericin.



References

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