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Cyanophycin Esterification: New biological Polycations with broad Application Potential

Technology Description

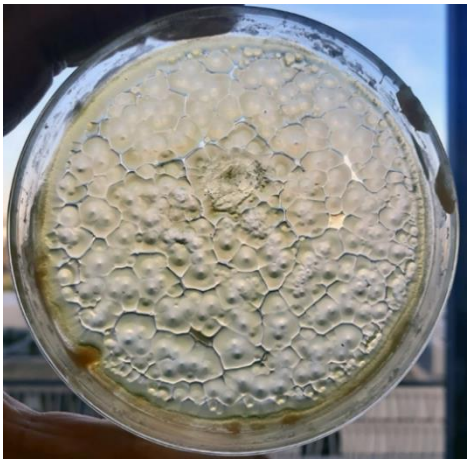

Figure 1a: *Room Temperature*

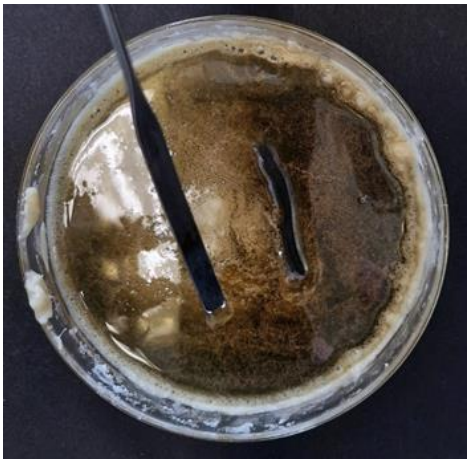

Figure 1b: *120° Celsius*

Figure 1: *Octanoyl-Cyanophycin solved in Octanol - a potential candidate for new adhesives. This new polymer shows properties of a hot-melt adhesive due to its reversible switching between solid state properties at room temperature (left side Figure 1a) and its highly viscous and sticky appearance at 120° Celsius (on the right, Figure 1b). The process is fully reversible - upon cooling, the polymer returns to a solid state.*

Cyanophycin (CP) is a biopolymer produced by bacteria[1]. Here we present an invention, by which we convert Cyanophycin through esterification into a sustainable raw material base for a broad range of applications. Choosing the appropriate alcohol in the esterification reaction renders polycations with varying physicochemical properties – covering solid, amorphous and liquid states. We are looking for industrial partners for licensing and developing this versatile new class of nature-derived material.

Innovation

Up to now: Cyanophycin under investigation as natural substitute for polymers (polyamide) made by chemical synthesis[2]. Practical use inter alia so far hampered by its low solubility

Now: New esterification process renders polycationic biopolymers with versatile physicochemical properties, soluble in water or organic solvents

IP Status

Priority-application with the DPMA.
Application number: 102021126431.6
PCT-application filed.
Application number: PCT/EP2022/078414

High-performance strains of Cyanobacteria for production of Cyanophycin (> 60 percent of cell dry mass) also available from our lab

Potential Applications

- Biotechnology: New polycationic carriers of nucleic acid in transfection experiments
- Medicine: New antimicrobial foils for dressings in surgery or applications in sanitation environments
- Food market: New polymers for antiseptic packaging of perishable materials
- Industry: New raw base for glues, gums, adhesion and coating materials, new materials for ion exchange columns

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Examples of Potential Applications

Antibacterial Properties: Propyl-CP

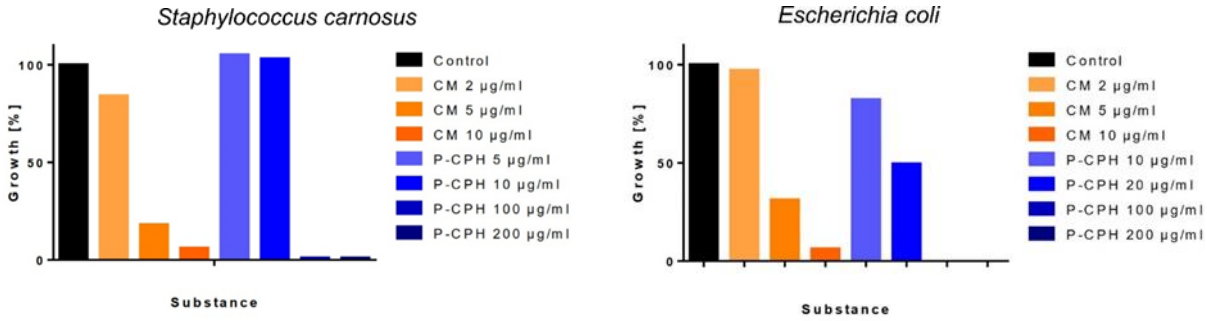

Figure 2: *Propyl-Cyanophycin: A candidate for new antibacterial substances. This Cyanophycin ester shows high antibacterial activity against gram positive and gram negative pathogens (CM: Chloramphenicol. P-CPH: Propyl-ester of Cyanophycin).*

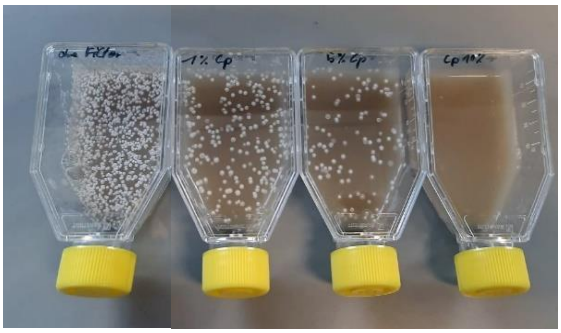

Figure 3: *We also tested Propyl-Cyanophycin as tool for antiseptic fleeces. Textile mats were initially soaked in varying concentrations of Propyl-Cyanophycin, dried and thereafter used for filtration of air contaminated with spores of Streptomyces spec. Figure 3 shows the results after three days for no filtering of air (control, left side) and filtering with fleeces soaked in a solution with 1%, 5% and 10% Propyl-Cyanophycin. The latter cleared any contamination from the air.*

Transfecting Agent: Ethyl-CP

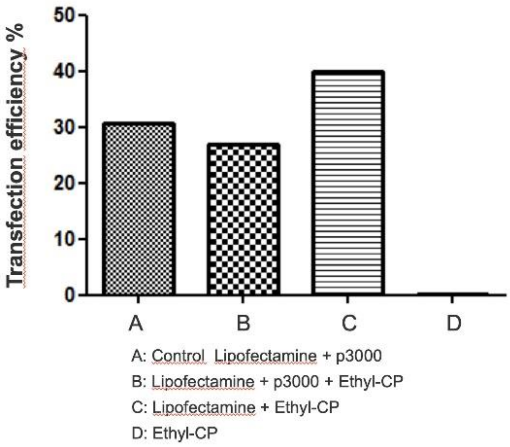

Figure 4: Ethyl-Cyanophycin (Ethyl-CP) - *due to their cationic electrical properties, Cyanophycin esters are candidates for the development of biocompatible transfection agents for delivering nucleic acids to cells for scientific or even therapeutic purposes. The experiment in Figure 4 points to high transfection efficiency achieved by Ethyl-Cyanophycin compared to the common transfection agent p3000, with Ethyl-CP being less cytotoxic.*

Gelling Agent: 2,2 Thiodiethanol-CP

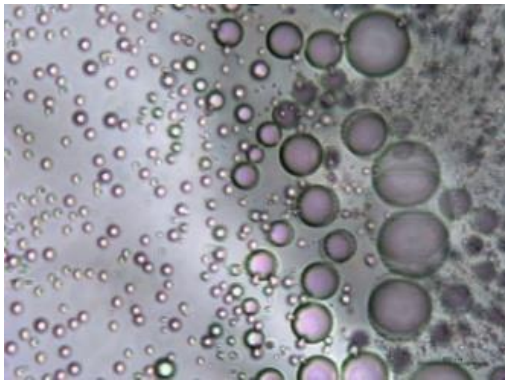

Figure 5: 2,2 Thiodiethanol *modified Cyanophycin shows a strong hydrophobic behavior. Its sticky, greasy and gelling properties make it a candidate for new lubricants.*

References

1 Watzer, B., Klemke, F. and Forchhammer K. (2020) The Cyanophycin Granule Peptide from Cyanobacteria. in: Bacterial Organelles and Organelle-like Inclusions (Springer), p. 149- 176

2 Koch, M. and Forchhammer, K. (2021) Cyanobacterial Biopolymers. In: Cyanobacteria Biotechnology (Wiley-VCH) https://doi.org/10.1002/9783527824908.ch10