

# Single-molecule force spectroscopy to compare the surface properties of food Propionibacteria strains with distinct abilities for EPS production

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*Propionibacterium freudenreichii* (PF) is a food grade bacterium with “generally recognized as safe” status, most commonly used as a starter for the manufacture of fermented dairy products such as Emmental and Leerdammer cheeses. It is also known for its production of vitamin B12 and propionic acid, and is studied for its remarkable anti-inflammatory properties<sup>[1,2]</sup>. Exopolysaccharide (EPS) production by food bacteria such as PF<sup>[3]</sup> is receiving increasing attention for their potential applications in improving both texture and the health properties of foodstuff. In this work, we explored the genetic and phenotypic bases for the surface properties of the EPS-producing PF strain P52. In this purpose, the whole genomes of the EPS-producing PF P52 strain and of its spontaneous mutant, with an altered EPS-phenotype, were analyzed to identify genetic determinants for EPS biosynthesis. Using lectin-grafted AFM probes, single-molecule force spectroscopy was used to stretch EPS polymers over immobilized individual bacteria<sup>[4,5]</sup> of both strains. Results evidenced that spontaneous mutation could lead to 10-fold shortening of the EPS length. Application of the extended Free Join Chain model indicated up to  $30 \times 10^3$  Kuhn segments for the EPS-producing mutant, vs  $5 \times 10^3$  for the mutant.

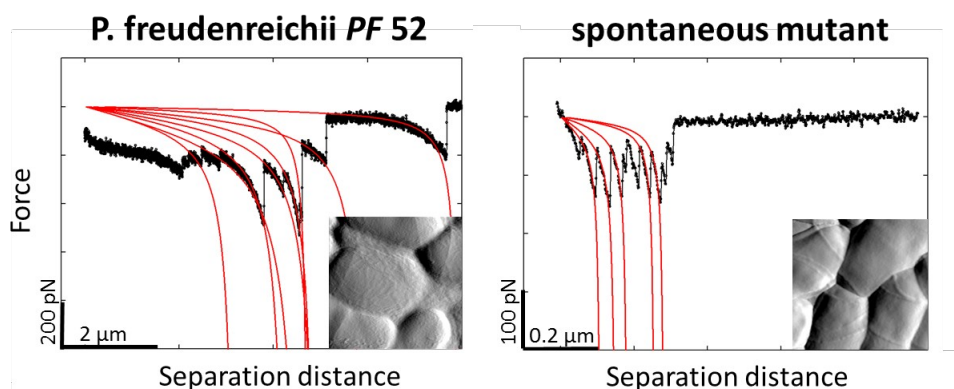


Figure 1: Typical deflection images and single-molecule force curves obtained by AFM analysis of the wild-type EPS-producing *P. freudenreichii* strain (left) and of its spontaneous mutant (right)

Combination of genetic data and force spectroscopy observations provided insight on the biosynthesis of EPS with variable lengths, therefore on the control of thickness of the bacterial capsule for specific food applications.

## References

- [1] A. Thierry et al., *International Journal of Food Microbiology*, **2011**, 149, 19-27
- [2] S.-M. Deutsch et al., *Scientific Reports*, **2017**, 7, 46409
- [3] S.-M. Deutsch et al., *Appl Environ Microbiol.*, **2012**, 78, 1765-1775
- [4] P.E. Marszalek, Y. Dufrêne, *Chem. Soc. Rev.*, **2012**, 41, 3523-3534
- [5] G. Francius et al., *ACS Nano.*, **2008**, 2, 1921-1929