Development of a simplified lipid model of bacterial membrane to investigate specific interactions with oligosaccharides

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The European PREMIUM project aims at proposing new eco-friendly strategies to preserve lactic acid bacteria (LAB). One approach considered is the development of new protective agents in order to allow the application of more aggressive drying processes than freeze-drying. Recently, oligosaccharides such as fructo-oligosaccharides and galacto-oligosaccharides have been reported as promising molecules for protecting LAB. It is generally assumed in the literature that direct interaction between membrane and protective agent is important to stabilize membrane during water removal. The ability of oligosaccharides to interact with bacterial membrane will be dependent not only on their sugar composition but also on the lipid membrane composition. The objective of this study is to develop a simplified lipid model representative of bacterial membrane to investigate the specific interaction between oligosaccharides and lipids. The membrane of two strains of lactic acid bacteria exhibiting different freezing resistances and extremely low survival to freeze-drying were fully characterized to determine lipid composition and lipid phase transition. Lipid membrane models of various level of complexity were subsequently designed: i) liposomes and monolayers from bacterial lipid extracts; ii) liposomes from lipid extracts enriched with standard lipids, and ii) liposomes and monolayers made from two standard lipids. The standard lipids were chosen in accordance with the predominant lipids present within the bacterial membrane. The biophysical properties of these models were determined using Fourier Transform Infrared spectroscopy (lipid phase transition) and Langmuir isotherms (surface pressure area isotherms). Two binary lipid models satisfactorily representing the two bacterial strains according to their biophysical properties were set up and could thus be further used to investigate specific interaction between lipid and oligosaccharides.

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