Metabolome analysis and physicochemical analyses were executed with cell extracts of a Lactococcus lactis subspecies cremoris strain treated by moderate pulsed electric field (PEF) to elucidate the mechanism of enhanced production of exopolysaccharide (EPS) by the treatment. Metabolome analysis by capillary electrophoresis time of flight mass spectrometry annotated 224 metabolites from the cytoplasmic extract of the strain, which, however, showed no significant changes in metabolites related to the EPS production. Electron microscopic observation and chemical analysis of undecaprenoids as carrier of EPS biosynthetic intermediates suggested that PEF treatment dissociated immature EPSs from the intermediates due to the focal electro-condensation of hydrogen ions at the cell surface. Thus, liberated undecaprenyl phosphates were recycled efficiently, which resulted in mass increase of EPS with smaller molecular weight. The study suggested the feasibility of moderate PEF treatment as a food processing technique and revealed the mechanism of enhanced production of EPS by the treatment.

Diagrams explaining electro-chemically induced hydrolysis of phosphodiester bonds of EPS biosynthetic intermediates and release of immature EPS into the medium.