

Abstract

The chapter about the Gram-positive bacterial cell wall gives a brief historical background on the discovery of Gram-positive cell walls and their constituents and microscopic methods applied for studying the Gram-positive cell envelope. Followed by the description of the different chemical building blocks of peptidoglycan and the biosynthesis of the peptidoglycan layers and high turnover of peptidoglycan during bacterial growth. Lipoteichoic acids and wall teichoic acids are highlighted as major components of the cell wall. Characterization of capsules and the formation of extracellular vesicles by Gram-positive bacteria close the section on cell envelopes which have a high impact on bacterial pathogenesis. In addition, the specialized complex and unusual cell wall of mycobacteria is introduced thereafter. Next a short back view is given on the development of electron microscopic examinations for studying bacterial cell walls. Different electron microscopic techniques and methods applied to examine bacterial cell envelopes are discussed in the view that most of the illustrated methods should be available in a well-equipped life sciences orientated electron microscopic laboratory. In addition, newly developed and mostly well-established cryo-methods like high-pressure freezing and freeze-substitution (HPF-FS) and cryo-sections of hydrated vitrified bacteria (CEMOVIS, Cryo-electron microscopy of vitreous sections) are described. At last, modern cryo-methods like cryo-electron tomography (CET) and cryo-FIB-SEM milling (focus ion beam-scanning electron microscopy) are introduced which are available only in specialized institutions, but at present represent the best available methods and techniques to study Gram-positive cell walls under close-to-nature conditions in great detail and at high resolution.