A Blueprint of the Protoplast's Dwelling—Commentary

Keegstra K, Talmadge KW, Bauer WD, Albersheim P (1973) The structure of plant cell walls. III. A model of the walls of suspension-cultured sycamore cells based on the interconnections of the macromolecular components. Plant Physiol **51:** 188–197

Plant cells are encased in a cell wall that is composed of the most abundant polymers on this planet and contains some of the structurally most complex polysaccharides known. The wall assumes an extraordinarily diverse number of functions during the life cycle of a plant. The wall defines cellular shape, is responsible for cellular adhesion, and contributes to the strength and structural integrity not only of individual cells but also of the entire plant. Despite its necessary rigidity, the cell wall is a highly dynamic entity that is metabolically active and plays crucial roles in numerous cell activities, such as growth and differentiation, as well as recognition of plant pathogens and signaling pathways leading to plant defense responses. Plants meet this diverse multitude of functions through the various polymers present in the walls. These polymers are mainly cellulose, various hemicelluloses, and pectic polysaccharides and, to a lesser extent, glycoproteins and polyphenols such as lignin.

The Albersheim group was instrumental in establishing analytical methods that defined the complex structures of the polysaccharides present in the walls. In this particular publication, they expanded their view and looked at the wall as a whole. Based on numerous enzymatic and chemical fractionation techniques, they concluded that there are covalent cross-links between the hemicellulose xyloglucan, the pectins, and the glycoprotein network. Previously, they established that xyloglucan bound noncovalently to cellulose microfibrils (Bauer et al., 1973), and hence the first model of the molecular structure of a plant cell wall emerged.

Even though some of their findings had to be revised, such as the covalent link between xyloglucan and the pectins, which does not seem to be as prevalent as originally thought, later models published in 1993 (Carpita and Gibeaut, 1993) and 2004 (Somerville et al., 2004) still represent the basic wall model as presented in this seminal article, albeit with enhanced graphical representations. In fact, advances in electron microscopic techniques 20 years later allowed a more in-depth visualization of the wall architecture (McCann et al., 1992), and a number of aspects presented in the original wall model were confirmed.

Nowadays, there is a renewed interest in plant cell wall research and the lignocellulosics it is composed of as a renewable resource for the production of biofuels to mitigate the impact of greenhouse gas emissions derived from the burning of fossil fuels. The findings and model represented in this article gave scientists a blueprint of the wall structure that they want to dismantle for biofuel production. In addition, the extraction methods used in the publication make scientists aware of the complexity of a wall, how recalcitrant walls are to degradation, and what efforts will be needed to succeed in solubilizing its components.

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