

Introduction

Description

(A hard-copy is available at : http://www.glycopedia.eu/IMG/pdf/the_plant_cell_walls.pdf)

Observing a section of cork with a microscope that he had himself devised, Robert Hooke, discovered that the tissue had a honeycomb-like structure made of small spaces contained by walls, that he coined cells (from the latin word cellula, small compartment). He recorded his observations in his famous book Micrographia (1665). This conception of fundamental units was the basis of the studies by Marcello Malpighi (1628-1694) and Nehemiah Grew (1641-1712) of the microstructure of plant anatomy. In spite of being both eukaryotic, plant and animal cells differ fundamentally by the fact that the plant cell is encased in a rigid thick and strong wall around the plasma membrane, when the animal cell is surrounded by a thin and soft extracellular membrane. The presence of a thick wall around the cell membrane is an extracellular matrix shared by the prokaryotic cell of bacteria.

The wall serves several functions at the levels of the cell and of the whole plant :

- *a morphological role* : it determines the shape of the cells and their association and organization into tissues, and ultimately the plant morphology ;
- *a physical barrier* bringing support, strength, and rigidity to the plant. The mechanical strength of the cell wall allows the cell to sustain the internal turgor pressure ;
- *a biological barrier* against pathogens ;
- *a metabolic role* : it takes part in cell communication and transport and secretion system ; it has a role in cell differentiation and plant growth ; it can be source of oligosaccharide fragments that have hormone-like action, especially in defense mechanism against pathogen infection, inducing reaction against the attack. The cell wall-associated kinases (WAKs) of angiosperms link the plasma membrane to the carbohydrate matrix and can directly regulate plant cell wall functions (Anderson 2001) ;
- *a natural composite* material with multiple unique properties, with economic value for wood and fiber products (lumber and paper industries, and construction) and source of energy. Cell walls from crop plants are also important for food and feed.

There are three distinct anatomical regions in most plant cell walls : the primary wall, a thin layer which is the first laid down against the plasma membrane and develops during cell expansion ; the thick secondary wall, deposited against the primary wall and made of additional sub-layers ; the middle lamella, which joins adjacent cells together. Not all plant cells have a secondary wall, but all have a primary wall and middle lamella. Each region of the cell walls has its own chemical composition and arrangement of its constituting polymers.