Abstract:

The cuticle of apple basically consists of a cutin and wax layer in parallel, each with different structures and diffusion properties. In order to obtain an accurate description of moisture transport through this cuticular membrane, a complex finite element model was developed. Model geometries of cracks and lenticels were based on confocal laser scanning microscopy (CLSM) images of the cuticle. In all geometries separate diffusion coefficients were attributed to the different surface layers. These diffusion properties were experimentally determined by means of a gravimetrical set-up. In a first series of simulations with the developed model, actual diffusion coefficients were obtained for cutin, tissue and wax. These actual diffusion coefficients differed from the experimentally determined apparent coefficients by taking into account the specific contribution of cuticular features such as cracks, open and closed lenticels. Next, the 'actual' diffusion coefficients were used in the model to predict moisture loss during long-term storage. After six months the predicted moisture loss was 4.1% for 'Elstar' and 3.5% for 'Jonagold', which accorded well to the data retained from practice. In addition, the model was evaluated in three case studies to describe the effect of different surface structures, relative humidity and blocked lenticels on moisture loss of fruit in long-term storage.