Abstract

The success of controlled or modified atmosphere storage depends critically on transport processes of gases and moisture in the fruit. Too low an oxygen partial pressure in combination with too high a carbon dioxide partial pressure inside the fruit induces a fermentative metabolism which may cause off-flavours (e.g., ethanol) and storage disorders (e.g., core breakdown in pear). Excessive moisture loss may lead to shriveling of the fruit and a corresponding decrease of commercial value. *In vivo* measurement of gas and moisture transport inside the fruit is not trivial because their concentration is not necessarily uniform-for example, the oxygen concentration in the fruit center may be much smaller than just beneath the skin. Also, most measurement techniques are invasive and disturb the local gas or moisture gradients or have insufficient spatial resolution. Alternatively, mathematical models can be used to predict the local gas or moisture concentration inside the fruit. The advantage of such an approach is that *in silico* experiments and be carried out to evaluate the effect of many storage conditions and fruit parameters on the local gas or moisture concentration. In this presentation we will discuss gas and moisture transport models of increasing complexity. We will start with simple lumped models based on Fick's first law which are applicable when the internal resistance to flow is small compared to the skin resistance. If this is not the case, continuum type models. Such models combine diffusion transport with respiration kinetics and allow the prediction of the local gas and moisture concentration. They, however, fail to explain microscopic gas gradients which are important for understanding phenomena such as fermentation related physiological disorders. Multiscale models are basically a hierarchy of models which describe the transport phenomena at different spatial scales in such a way that the submodels are interconnected. Typically, *in silico* experiments are carried out at a predefined spatial scale to compute apparent transport parameters which are then used in a model which operates on a more coarse scale. This procedure is iterated over all scales until the macroscopic continuum scale is reached. The different models will be illustrated by some examples including gas transport in pear and moisture diffusion through apple cuticle.