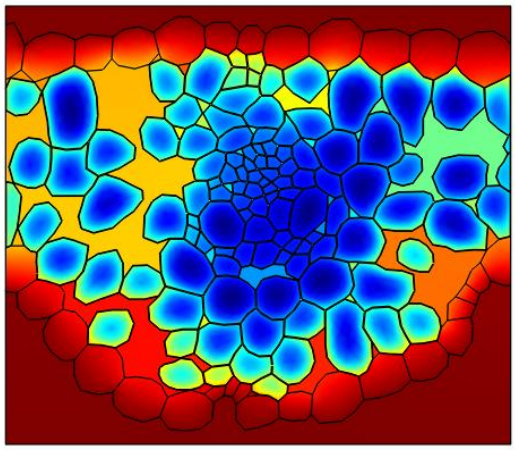
MULTISCALE MODELLING OF GAS EXCHANGE IN PHOTOSYNTHETIC TISSUE

The photosynthetic activity is a measure of the freshness of leafy vegetables. Photosynthesis involves exchange of O_2 and CO_2 of plants with their environment. Plants do not have specialised systems for gas exchange but rely on apertures in the epidermis such as stomata and lenticels and the intercellular air space within the tissue. As there is, to date, no good method to measure *in vivo* internal gas concentrations in plants, a mathematical modelling approach would provide an alternative to predict the internal gas concentrations. Multiscale gas exchange models are basically a hierarchy of models which describe the gas transport phenomena at different spatial scales. The models are coupled via *in silico* experiments, in which the model parameters relevant to a particular spatial scale (e.g., apparent diffusion parameters at the macroscale) are computed from numerical experiments at the microscale ('*homogenisation*').

The objective of this doctoral research project is (i) to extend an existing 2-D multiscale model for gas exchange of photosynthetic tissue to 3-D based on synchrotron microtomography images, and (ii) use this model to study gas exchange mechanisms and their effect on photosynthesis. Tomato (*Solanum lycopersicum* L.) leaf will be chosen as model system in a first phase of the project, but in a later phase leafy vegetables such as spinach will be investigated. The following aspects need to be considered in the research work:



- ✓ Construct a geometrical model of the leaf microstructure from available synchrotron X-ray microtomographic images
- ✓ Develop and apply models of CO_2 transport through stomata, the intercellular pore space and its assimilation in mesophyll cells of leaf using finite elements software;
- ✓ Conduct experiments and perform model validation studies;
- ✓ Disseminate the results to the international research community and industry

PROFILE

We are looking for an enthousiastic candidate with preferably a Master degree in exact sciences, with a keen interest in biology and who is able to combine experimental skills with mathematical modelling. International candidates with a MSc degree who have distinguished themselves during their education are encouraged to apply.

CONTACT

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