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Hairy roots as a smart alternative for the plant *in vitro* production of active agents – tissue culture in a compartmented STR and an object oriented growth modeling approach together with an automatic image recognition system

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Abstract

Secondary metabolites produced by plant *in vitro* cultures such as Betalains (red-dye in beetroot), the α-Tocopherol (Vitamine E) in sunflowers or Oleanolic and Ursolic acid found in sage are nowadays a main research focus within the branch of White Biotechnology. Cells genetically altered using *Agrobacterium rhizogenes* form hairy roots which can be cultivated in hormone free media in modern bioreactors [1].

To improve the cultivation process (higher yield, shorter cultivation time) and the bioreactor design (bubble column vs. stirred) a structured growth model with consequent simulations and visualization is presented as until now no theoretical description of the growth processes exist.

The determination of relevant parameters such as the number of branching points or specific segment length is carried out using an automatic image recognition software for pictures taken from the hairy root tissue networks on agar plates. With the presented innovative customized solution it is possible to quantitatively track a morphological growth process over the cultivation period [2].

The author presents a structured, object oriented growth model implemented as a finite state machine and calibrated with experimental imaging recognition data of the cultivations of *Beta vulgaris*. Results of the numerical simulations are displayed with a 3D-visualization engine and compared with experimental data. Additionally an Infors Multifors standard stirred tank reactor (STR) has been modified with a membrane-plate to culture *Beta vulgaris* and *Helianthus annuus* (sunflower) hairy roots successfully. With the modifications and six times higher biomass yield could be observed with a novel, patented biomonitoring method for inhomogeneous cultures [3].

Biography

Felix Lenk has completed his Master of Science in the field of Automation and Control in 2009 from Dresden University of Technology, Germany and from the University of Calgary, Calgary Alberta, Canada. In 2010 he started his PhD at the Dresden University of Technology at the chair of Bioprocess Engineering in the ESF-funded group “White Biotechnology with plant cells”. He was awarded with the InterLabTec-Award in 2011 and as of now has published several research articles in the field of plant *in vitro* tissue culturing and modeling.