Growth and product formation of Aspergillus oryzae during submerged cultivations: Verification of a morphologically structured model using fluorescent probes - DTU Orbit
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A morphologically structured model is well suited for obtaining a good description of growth and product formation of filamentous fungi for use in a process model, for example. This article describes a new morphologically structured model and its application to an a-amylase producing strain of Aspergillus oryzae. The model is based on a division of the fungal hyphae into three different regions: an extension zone, representing the tips of the hyphae; an active region, which is responsible for growth and product formation; and an inactive hyphal region. Two metamorphosis reactions describing branching and inactivation are included in the model, and the kinetics of branching and tip extension are based on known experimentally verified models of fungal microscopic morphology. To verify the structure of the model a double-staining method, based on a combination of fluorescence microscopy and automated image analysis, has been developed for measuring the fraction of active cells. The method employs the fluorescent dye 3,3'-dihexyloxocarbocyanin to stain organelles inside the hyphae and Calcoflour White to stain the cell wall. The ratio between the projected areas of the organelles and of the entire hyphal element is then taken to be proportional to the fraction of active cells. When applied to chemostat and fed-batch experiments, the double-staining method seemed to confirm the basic morphological structure of the model. The model is able to produce accurate simulations of steady-state and transient conditions in chemostats, of batch cultivations, and even the formation of a single hyphal element from a spore, all with the same values of the model parameters. (C) 1998 John Wiley & Sons, Inc.

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