Phenotypic characterization of Aspergillus niger strains in submerged cultivation and at the single cell level.

Jette Thykaer[1], Lars Poulsen[2], and Mhairi Mcintyre Workman*†[3]

[1]Center for Microbial Biotechnology – Technical University of Denmark – Building 223, Søltofts Plads, DK-2800 Kgs. Lyngby, Denmark, Denmark
[2]Center for Microbial Biotechnology – Technical University of Denmark – Building 223, Søltofts Plads, DK-2800 Kgs. Lyngby, Denmark, Denmark
[3]Center for Microbial Biotechnology – Technical University of Denmark – Building 223, Søltofts Plads, DK-2800 Kgs. Lyngby, Denmark, Denmark

Abstract

Aspergillus niger is a well studied filamentous fungus, utilised worldwide for the industrial production of citric acid and enzymes. Efficient production of citric acid by A. niger is dependent on controlled bioprocessing conditions, with optimal production when trace metals are limiting and medium pH is below 2. Traditionally, Metabolic Engineering approaches for improving the cellular performance of this important industrial strain has been achieved by genetic engineering of a single gene or a metabolic pathway. However, this approach suffers limitations with respect to regulation of metabolic pathways. Essential players in the overall regulation of metabolism in A. niger are pH-responding transcription factors as they have the potential of controlling several pathways. Manipulating expression of these transcription factors are therefore of particular interest in terms of developing efficient cell factories. In this study, we constructed a mutant carrying a deletion in a putative pH dependent transcription factor. Results from submerged cultures indicated an interesting phenotype as the maximum specific growth rate was increased by 29% from 0.21 h-1 in the wild type to 0.27 h-1 in the constructed strain. Furthermore, the mutant strain showed significantly lower yield of acid on glucose. This combination of higher growth rate and lower acid production was further investigated on the level of single hyphal elements. Focusing on the classical morphological parameters i.e. hyphal growth unit, tip formation rate, tip extension rate and specific branching rate, the resulting phenotype of the mutant strain was characterized in detail and related to the estimated increased growth rate.

Keywords: Phenotypic characterization, Aspergillus niger, submerged cultivation, single cell level

*Speaker
†Corresponding author: mwo@bio.dtu.dk