Bioluminescence-based system for rapid detection of natural transformation

Horizontal gene transfer plays a significant role in bacterial evolution and has major clinical importance. Thus, it is vital to understand the mechanisms and kinetics of genetic transformations. Natural transformation is the driving mechanism for horizontal gene transfer in diverse genera of bacteria. Our study introduces a simple and rapid method for the investigation of natural transformation. This highly sensitive system allows the detection of a transformation event directly from a bacterial population without any separation step or selection of cells. The system is based on the bacterial luciferase operon from Photorhabdus luminescens. The studied molecular tools consist of the functional modules luxCDE and luxAB, which involve a replicative plasmid and an integrative gene cassette. A well-established host for bacterial genetic investigations, Acinetobacter baylyi ADP1, is used as the model bacterium. We show that natural transformation followed by homologous recombination or plasmid recircularization can be readily detected in both actively growing and static biofilm-like cultures, including very rare transformation events. The system allows the detection of natural transformation within 1 h of introducing sample DNA into the culture. The introduced method provides a convenient means to study the kinetics of natural transformation under variable conditions and perturbations.