CRISPR technologies for bacterial systems: Current achievements and future directions - DTU Orbit (13/09/2018)

Throughout the decades of its history, the advances in bacteria-based bio-industries have coincided with great leaps in strain engineering technologies. Recently unveiled clustered regularly interspaced short palindromic repeats (CRISPR)/CRISPR-associated proteins (Cas) systems are now revolutionizing biotechnology as well as biology. Diverse technologies have been derived from CRISPR/Cas systems in bacteria, yet the applications unfortunately have not been actively employed in bacteria as extensively as in eukaryotic organisms. A recent trend of engineering less explored strains in industrial microbiology-metabolic engineering, synthetic biology, and other related disciplines is demanding facile yet robust tools, and various CRISPR technologies have potential to cater to the demands. Here, we briefly review the science in CRISPR/Cas systems and the milestone inventions that enabled numerous CRISPR technologies. Next, we describe CRISPR/Cas-derived technologies for bacterial strain development, including genome editing and gene expression regulation applications. Then, other CRISPR technologies possessing great potential for industrial applications are described, including typing and tracking of bacterial strains, virome identification, vaccination of bacteria, and advanced antimicrobial approaches. For each application, we note our suggestions for additional improvements as well. In the same context, replication of CRISPR/Cas-based chromosome imaging technologies developed originally in eukaryotic systems is introduced with its potential impact on studying bacterial chromosomal dynamics. Also, the current patent status of CRISPR technologies is reviewed. Finally, we provide some insights to the future of CRISPR technologies for bacterial systems by proposing complementary techniques to be developed for the use of CRISPR technologies in even wider range of applications.
Antimicrobials, CRISPR/Cas system, Cas9, bacteria, Expression regulation, Genome editing, Imaging, Typing, Vaccination of bacteria, Virome

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